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Professor Gabrielle Hecht's work on uranium communities is arguably unparalleled in its scope and significance. While unveiling and deconstructing uranium's role in a globalised and militarised world, she has undertaken a meaningful exploration of its global linkages from local injustice to issues of planetary scale.

Hecht's work extends across and beyond the nuclear fuel cycle, to explore the global circulation and regulation of nuclear things, from uranium mining to nuclear power plant technopolitics. Her work is transnational in nature, yet also considers local politics, as she creates new understandings of the 'nuclear condition' and the constitutive role of nuclearism in the formation of national identity (Hecht, 2012a, 2012b). Her work reveals nuclearity to be an imbricated, shifting and unstable subject - a culturally and socially critical mass.

To understand uranium's physical relevance to our world, it is necessary to trace its future isotopic longevity across the aeons, to consider the unnatural nature of the artificial radioisotopes produced by nuclear fission. To understand the meaning of uranium's place in society, it is important to look beyond the secret cities and the covert military technologies of the Cold War. Hecht painstakingly identifies the role of globalisation in perpetuating systemic injustices, by considering how 'regulatory arbitrage' has legitimised this toxic flow of uranium from Global South to Global North. This has enabled unregulated waste to accumulate in underserving spaces, creating an uneven Anthropocene.

Uranium has contributed to de-development in Africa and beyond, as lax environmental legislation has allowed the pollution of natural resources and the localised dispersal of contaminated tailings from mining and milling processes. This process of nuclear exceptionalism creates ontological insecurities, where uranium is as unspecified technologically as Africa is politically (Hecht, 2006).

However, this was not the only mode of dispersal. This uranium was processed and used for the nuclear weapons that were detonated by the USA and UK, releasing radionuclides high into the Earth's atmosphere, gently floating free of currents and smattering the world with artificial radioisotopes, traces of the Anthropocene. A single universality of exposure, in a world of burgeoning "south-south" development that offers only greater inequality and a form of commodity colonialism, as minority communities near uranium mines are marginalised (DeBoom, 2018).

Professor Gabrielle Hecht is the Frank Stanton Foundation Professor of Nuclear Security at Stanford University. She is the author of several pioneering books and papers that explore the meaning of living in an atomic world, including *Being Nuclear: Africans and the Global Uranium Trade* (2012) and *The Radiance of France: Nuclear Power and National Identity* (1998 & 2009). She is currently writing *Toxic Tales from the African Anthropocene*, a new collection of essays that analyse the entanglement of radioactive and other types of waste in Africa.

Dr Becky Alexis-Martin talks here with Professor Gabrielle Hecht about her long-standing motivations for understanding the global flows and networks that surround uranium, and its entangled significance to our unevenly distributed Anthropocene.

1. You began your career in the physical sciences by studying for a Physics degree at Massachusetts Institute of Technology (MIT). Why did you decide to expand your remit beyond physics, and what drew you to the social sciences?

I initially went to MIT to be an astronomer and I discovered that lonely cold nights outside were not for me. Then I contemplated becoming an astrophysicist, but learned that writing FORTRAN programs to analyse images taken from outer space was also not for me.

MIT was a peculiar place, filled with socially awkward nerds – and many more men than women. In my undergraduate cohort in Physics, there were around eighty majors, of which six were female. That was an even bigger gender disparity than at the Institute as a whole, where a quarter of the undergraduate students were female.

I was there from 1982 to 1986. Two big political movements dominated the scene. The first was Reagan's Strategic Defence Initiative (SDI), also known as "Star Wars". This had huge implications for MIT, an institution that relied on defence funding for much of its research. The second was the anti-apartheid movement, with students lobbying in favour of MIT's divestment from South Africa. The movement against Reagan's SDI helped me realise that I was much more interested in the politics of science and technology than I was in actually doing science. (The effect of anti-apartheid politics on my work would only manifest later.) I took some STS (Science and Technology Studies) classes, and I thought "well, maybe this is for me". From there I went to graduate school and began reading history and sociology of science and technology, and discovered that this was indeed the right field for me. It was an organic move.

I had two different experiences training in STS. One was the department where I got my PhD: History and Sociology of Science at the University of Pennsylvania, where I had the extraordinary chance to work with the venerable Thomas Parke Hughes. I also had the great good fortune, during my dissertation research year (1989–1999), of being affiliated with the Centre de Sociologie de l'Innovation (CSI) at the l'Ecole des Mines in Paris, where Bruno Latour and Michel Callon were working out what's now known as Actor Network Theory. Among other things, I learned how to do oral history and conduct ethnographic work there. At both places, I benefited from amazing fellow graduate students, in addition to these senior scholars. Living in two quite differently inflected STS communities gave me a sense of STS as an expansive world that could incorporate people from many disciplinary perspectives and political outlooks, taking on a wide variety of empirical topics and approaches. As a graduate student, I found the intellectual and methodological diversity of the field very congenial.

2. How has your interdisciplinary background informed your work as a historian and social scientist?

I did not learn nuclear engineering as a physics undergraduate. The physics degree did mean that reading scientific papers and trying to figure out how reactors worked was not inherently intimidating. I felt, "I can figure this out, I can talk to people and learn about it". The background was useful in that sense.

But overall, the degree has been more useful socially than intellectually. It impresses people, which was particularly helpful for my first project, when I was interviewing elderly and middle-aged men. I was 23 when I started that research, and I looked even younger. Being able to say that I had this degree in physics from MIT gave me some credibility.

3. To what extent do you think that the social justice issues that we currently face have arisen due to a disconnection between the physical and social sciences?

I think many of the social justice issues that the world faces are due to straightforward regimes of inequality, whether these be racial, economic, gender, or other axes of difference. And yes, we have created robust institutions predicated on a separation between the physical and the natural and social sciences. The fact that such institutions are part of the structures of inequality often leads to the treatment of environmental challenges as issues that can be addressed entirely with the tools of natural science and engineering, and that don't need to be subject to social or political analysis.

I recently had lunch with Paul Ehrlich, the population biologist, who retired from Stanford some years ago. He said that he once proposed to the administration at Stanford that they shut the entire university down for a year, dissolve all the departments, and reconsider the whole organisation because, as he put it, "...there isn't a single problem in the world that can be addressed by just one discipline".

4. Your work delves into the liminal spaces and people that surround the nuclear industry. When did you first become aware of these communities, and why do you think it is important that their experiences are explored?

My first book on the French nuclear industry sought to go beyond what was then a dominant focus in STS, namely the politics of technological design. I wanted to relate those politics to labor issues, and also to the communities that hosted the nuclear reactors. For the second project, I wanted to go further. At the time, I was involved in a reading group on "Empires and Cultures" that I helped to run along with two my senior colleagues. I became interested in how technological change was implicated in imperial expansion and racial inequality. I was actually trying to get away from nuclear topics. But at some point, I realised that I had just spent all of this time researching and writing about French nuclear power and had paid absolutely no attention to where the uranium was coming from. Then I saw that very few people had written about this. Such work as existed focused intensely on specific regions. For example, there was a lot of work in Australia by local anthropologists on the development of the Ranger uranium mine in the Northern Territory and its relationship to Aboriginal land rights and environmental politics; something similar applied on Native American lands – especially the Navajo Nation. But I couldn't find any work that linked places together to offer a different overall perspective on the nuclear world. I started digging into these subjects, and saw that

scholars (regardless disciplinary or national background) had almost completely ignored uranium production on the African continent. So that's how I got to the topic of the book *Being Nuclear*.

5. How have your personal experiences of researching uranium unfolded? Have you experienced any challenges or contestations of your work by the states and places that you have studied?

This answer is going to surprise you. I've actually had tremendous good fortune in gaining access to company archives. I think that was for a variety of different reasons. In the case of the Rössing mine in Namibia, I got access to the site by making contact with someone at NUFCOR, the company that processes yellow cake in South Africa and sells it on the international market. This person had actually read my first book.

Now, the odd thing about the reception of my first book is that it was positively received by both the nuclear industry and by anti-nuclear activists. I think that one reason it was read positively by the industry is that the book doesn't discuss health and environmental issues. That was in part because I couldn't get access to health or exposure records. But the net result was that I seemed less threatening to the nuclear industry. So I suspect that my contact at NUFCOR probably thought, "She's neither pro nor anti-nuclear, this would potentially be a good person to let into the archives and have a rummage around, because she's not going to use it to make a big case against us, and this shows that we are open and impartial". I'm speculating of course, but the fact is that Rössing gave me unlimited access. It was incredible: I saw thousands of pages of documentation.

By contrast, I faced huge obstacles in Australia. In my initial formulation – which held for several years before I decided to limit my focus to the African content – the project included not just the African sites, but also Aboriginal lands in Australia and Native lands in the USA and Canada. So I spent several months in Australia conducting research. It turned out that the Ranger uranium mine there had been exhaustively studied as a result of a big public inquiry process set up to assess the changing social and environmental impact of Ranger's uranium mining over time. So for the previous 25 years, the zone had been inundated with anthropologists and environmental scientists. In that context, I was just another annoying researcher. I understood that, but the weird part was that some of the environmental activists had positioned themselves as the gatekeepers – really more of a firewall — for the Mirrar community of Aboriginal people who lived in the region. These activists put up numerous blocks. They refused to talk to me. One of them even insulted me. They treated me like the enemy.

6. What are the defining characteristics that link uranium to the Anthropocene?

Geologists at the International Commission on Stratigraphy are trying to identify the so-called "golden spike" that would date the Anthropocene as a geological era. One of the markers that they keep coming back to is nuclear testing. One proposal was to take the moment of the explosion on July 16th 1945 in Alamogordo (USA) as the exact second when the Anthropocene began. Then they backed off that precision and suggested instead the 1950s, the big decade of nuclear testing, which matches the uptick represented by the so-called "great acceleration." So if the Anthropocene indicates an acceleration in the rearrangement of our planet's geology of the planet — taking things

that were apparently fixed in the planet's crust, extracting them, processing them, and spreading them all over the place — then uranium is an especially good indicator. Especially when you consider atmospheric nuclear testing, and the direct connections between that testing and climate science research (connections that other colleagues have written about).

A lot of writing on the Anthropocene attributes planetary collapse to humanity writ large. But of course only some humans are responsible for this activity. And different places and communities feel the effects of planetary change differently. In the communities where uranium was mined, it's effectively a super-indicator of the Anthropocene — especially as the effects of its extraction are ongoing. There are many ways into the Anthropocene, so I would not claim a special place for uranium, but I think that it's an awfully productive one.

7. How have attitudes of a technopolitical nature resulted in adaptations to your approach towards uranium and social justice over time?

I began working on the project from 1998. In 2003, you'll recall that then-President George W. Bush declared that Saddam Hussein was buying "uranium from Africa." That was one of the big justifications for the Iraq war. That's part of what pushed me to narrow my focus to African uranium production, to the exclusion of these other places that I'd been looking at.

8. Could you give me your perspective on the changing role of women in uranium extraction and production research?

I have been struck in recent years at how much cutting-edge research and writing on nuclear topics has been produced by women humanists and social scientists: Sonja Schmid, Soraya Boudia, Sezin Topçu, Lindsay Freeman, and many others. (I'm leaving out lots of people, for which I apologise!) I haven't run any numbers to see how strong a pattern that is, though.

On a totally different front, and to go back to Namibia: when I was at the Rössing Mine, doing my research in 2004, they had just hired about a dozen young women to drive those huge tractors, extraction machines that are the size of a three-storey house. I got to ride in one with the driver, a 21 year old Namibian woman. She told me about how exciting it was for her to have this opportunity, but also (and totally unsurprisingly) that there was resistance from older male workers, who didn't like the idea that women should have the chance to run the biggest and fanciest machines on the mine (not to mention the fact that the cabs where the drivers sat were air conditioned).

9. Why does scale have particular significance for issues pertaining to uranium and social justice?

In a recent piece for *Cultural Anthropology*, I explored how scale is both a source of political claims-making and an epistemological infrastructure. We all think in scalar terms, but at the same time we have to be attentive in which the ways that claims to scale arise ("that's a global problem, this is a local problem..."). Those claims about scale are themselves political, but that shouldn't mean that we then abandon scale as a unit of analysis: we just need to be attentive to the dynamics involved.

With that in mind, I see uranium as an inter-scalar vehicle. Its decay can produce tiny particles that get lodged inside people's lungs and affect them years down the line. At the same time, when you put enough uranium together in the right way, you can produce these gigantic explosions. Attending to these scalar shifts helps us understand and deal with multiple registers in which the use of uranium has both created and destroyed communities, while also giving us insight into the deep history of the earth. Paying attention to scale as simultaneously an actor and an analytic category helps us keep the contradictions active, rather than trying to resolve them. I think this aids the Anthropocene project by leveraging the ways in which researchers across the natural, social and human sciences – as well as the arts – grapple with scale in order to better understand the complex dynamics that put our species at risk.

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