



graduate
education
beyond the
classroom

History Beyond the Classroom
Report on the Aramont Foundation
Graduate Education Innovation Fund.
Department of the History of Science,
Harvard University

This volume is dedicated to Javier Arango, whose decades-long friendship, intellectual engagement, and support of the Department of History of Science has meant so much to all of us, students and faculty. The program sketched here, Graduate Education Beyond the Classroom, reflects his passionate commitment to scholarship. His vision lives on in the work of our graduate students, past, present, and future.

— Peter Galison for the Department
of History of Science

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PART 1: TEACHING BEYOND THE CLASSROOM: A NEW MODEL OF GRADUATE INSTRUCTION

This is a moment when the idea of graduate education can be reconfigured to venture beyond text, lectures and class, and the Department of the History of Science at Harvard University is singularly well positioned to pave the way. Over the last years, this department has been at the forefront of expanding not only the content of what the field of history of science does, going beyond established disciplinary boundaries to integrate historical, anthropological, and sociological approaches; but also the methods by which we teach this content, exploring new pedagogical techniques from the preparation of Massive Open Online and hybrid (“flipped”) courses to filmmaking, interactive web design, material objects, museum exhibitions, site-specific teaching, research, and learning.

Our aim is to deepen and broaden this work so our faculty and students can rethink pressing historical problems with contemporary relevance. Historians of science are now less likely to hew to subdisciplines (the history of physics, the anthropology of biology), and more likely to address cross-cutting thematics and problems that stretch across multiple domains of scientific and social thinking and doing. Furthermore, budding scholars now turn their attention to sites of technoscientific labor, from hospitals and laboratories to nuclear facilities and ecological sites. Finally, methods in the history of science are newly open to revision – while the archive is still fundamental to our work, so too are the ethnographic field site, literary and media interpretation, and collaboration with natural and social scientists.

An important corollary is that our graduate students gain important skills that can open up a wide range of post-PhD career paths. Integrating history of science with exhibit-making has given several students the chance to go on to work in historical and scientific museums (at the Smithsonian, for instance). Some of our students have combined history of science with filmmaking and other digital media – one is now among the hosts of RadioLab – while others have used their skills to gain professorial appointments beyond history of science (in Rhetoric, at Berkeley). Another brings film into her joint study of the history of cell biology and its practice.

Some seven years ago, the History of Science Department judged that, with some additional resources, it could produce a program of collaborative teaching that would dramatically benefit graduate students, postdocs, and indeed the faculty itself – while at the same time serving as a model for other departments at and beyond Harvard. The proposed program would extend the traditional aims of the research and teaching university to join these goals in innovative, experimental, and collaborative ways.

The Aramont Foundation offered the Department a bequest in 2015 to pursue just these goals. Established by Javier Arango, a graduate of Harvard University and a passionate supporter of educational opportunity and diversity, the Aramont Foundation Graduate Education Innovation Fund is intended specifically for the Department of the History of Science. Mr. Arango’s hope was to transform graduate students’ understanding of their future roles as researchers and educators by expanding their experiences beyond the traditional academic sphere. He was particularly keen to enable faculty members to generate collective learning experiences in the wider world. “History beyond the Classroom” now ranks among the most valuable and distinctive resources available to our graduate community. It has been deeply formative in the professional development of students since 2016, when the first learning expedition

took place. Four expeditions, or what could be called ‘movable seminars’, have taken place, each lead by one or two faculty members and comprising about 6-8 graduate students.

In March 2020, the COVID virus made it stunningly clear that we would have to confront the *totality* of our educational work beyond the classroom – in this instance without the possibility of fieldwork or any of our alternate-site ideas. We turned that necessity into opportunity, developing a new range of educational innovations, many of which we expect will prove of lasting value even after the pandemic has receded.

Some examples, discussed in more detail in the body of this report: One of the consequences of the pandemic shut-down has been the sudden unavailability of archives, a development that hit a myriad of research areas not only in history of science but also far beyond (history, political science, economics, just to name a few). Under the guidance of Professor Hannah Marcus from the History of Science Department, we established a seminar in which all the participants were offered modest grants to procure digitized archival materials that they needed for their research – after which they met online as a group over the course of an intensive week. The students were able to come to the methodological table, so to speak, and in discussion of their particular archive sets were encouraged to address the kind of questions that could be put to the archives in general: How to handle note taking and information management? How to integrate published and unpublished sources? This seminar has been an immense success, and Professor Marcus will be offering it again in the near future.

Second, Professor Matt Hersch teaches the history of computing, and the history of technology more generally, through an encounter with material objects. Not willing to give this up, he used some of our





Hannah Conway, 2016

Beyond the Classroom funds to buy obsolete computer parts and send them to the seminar participants directly at their homes. So while the course took place online, each seminarian had access to altogether material study objects – a very different matter indeed than merely working with internet images.

A third venture: Since 2001 or so, the reanimated Collection of Historical Scientific Instruments has played an integral part of our graduate program. Exhibits on cold war science, on the Turing Test, on the history of anatomical dissection, on the Rorschach Test (among many others) have been an essential part of our teaching. At the beginning of the pandemic, we were on the verge of opening a major exhibit on the role of visual materials in Freudian thought. Unable to proceed – all our museums shut down with no horizon of reopening – we re-directed our efforts toward making a novel form of interactive exhibit.

Finally, it goes without saying, digital resources have become ever more ubiquitous in graduate education – often without our reckoning with what is lost when we drop, almost entirely, the actual bound book. With libraries shuttered during the pandemic, we began to see just what it was we had foregone. In response, Professors Elizabeth Lunbeck and Peter Galison established a new methods seminar for all first and second year students, with three distinctive aspects. First, eight relatively young scholars were chosen, each the author of a major, methodologically significant book, and invited to speak (one at a time, of course, via Zoom, about one per month). Each spoke in this key graduate seminar about their work, and equally importantly, about their career trajectories. This meant a great deal to our graduate students: it is never easy to imagine the path forward in a career, and in the midst of the fragmented social world of the pandemic it was all the more true. Second, we distributed hard copies of the books to the seminar; students were especially grateful for this small but meaningful gesture. Third, students took the lead in seminar. Everyone wrote up their impressions of the reading, and during the actual meetings, three students served as guides, introducers, and discussion moderators, gaining valuable professional experience in doing so. Somehow the encounters with the authors, their very honest recounting of their own (still recent) careers, and real books made a lasting impression.

COLLABORATION THROUGH MEDIA, MATERIALITY, AND METHODS

A number of our students have begun working on a graduate secondary field in Critical Media Practice, which trains them in digital media production (film, audio, and web) and guides them in making such products an added dimension of their written theses. We will be able to offer some support for our students participating in these projects. Other graduate students play an increasingly central role in the design of museum work through the Collection of Historical Scientific Instruments. With some more resources, we have been able to boost the availability of the equipment and curatorial supervision so that a significantly larger number of our advanced students could make use of these new methods of using digital and material objects. Key to making this and other broadly conceived new methods work is *to join graduate students and faculty in collaborative research efforts*. Not by relegating students to helpers in conferences, but instead by including them in the whole process of thinking through new ways of approaching the discipline that would culminate in yearly, well-prepared workshops that would test these novel assemblages of media, materials, and new source materials.

FUTURE PROJECTS:

Taken together, these efforts and others aim to set the agenda for a new generation of work in the history of science. We want to deepen and expand the novel teaching and research methods that we have been exploring. For example, scholars today are very familiar with working one by one; almost all our institutions encourage this individualized approach. We want to shake up this convention and bring people together as co-explorers through teaching, and more broadly through lab-like settings that will become a trademark feature of this program. We plan to pursue our curatorial museum projects, break new ground in digital methods, and develop joint site-specific work that would foster collaborative thinking about scientific spaces like the Nevada Nuclear Test Site, Antarctica, NASA, or the Galapagos Islands. End products would include inventive installations from our collection of scientific instruments (some online, some in physical galleries), novel interactive digital forms, and films, books, and articles addressing these new approaches. We anticipate this new pedagogical initiative will include three integrated components (outlined below) that, together, open up learning beyond the classroom.

The Department would extend and develop forms of research/learning beyond the seminar and the lecture. We would like, in a more consistent and deepened way, to run “master classes,” for example, bringing in particularly innovative scholars from across the disciplinary map for short but highly intense participatory residency studies that would, in the first instance, be open to our students and faculty, but could also later include others from history, philosophy, and other departments in the social and natural sciences. The master class visitor would read and respond to students’ work and meet for intensive discussion with both students and faculty about work in progress over the course of a week or so. (This program would be modeled on what is standard practice in music departments, where, for example, a great cellist would demonstrate but also critique and refine the work of advanced students.) Graduate students would benefit not only from interacting with these scholars, but also would get a sense of “being in the game,” providing support as they advance along the pathway to being full-fledged scholars.

Graduate education is in a precarious situation these days – but it is also, in our view, the very foundation of the research university that had its beginning only some 150 years ago in Germany and the United States. If these institutions are to remain vibrant, if they are to serve as guardians of the hard-won scientific, social scientific and humanistic accomplishments that we so value, if they are to provide a springboard into the future, then we need to be experimenting with new ways to train leaders across many fields. This effort at graduate education beyond the classroom is a modest but very open venture to serve as a laboratory for those new modes of research, teaching, and learning. We are happy to share the first fruits of this labor with you. May this serve as an invitation to discussion and to the generation of new ideas about how to proceed – ideas still unthought.

TRIP 1: TECHNICAL LANDS, AUGUST 21-28 2016

Prof. Peter Galison

Research Assistant: Leah Aronowsky

Our “Technical Lands” expedition was the first of the Department of the History of Science’s field research trips for the “Graduate Education Beyond the Classroom” program, a series of four major trips and additional small-scale trips that have taken place over the past five years. Included in our group for this trip were five graduate students and two faculty members. We traveled to the Southwest for an intense week of work – exploring the variety of ways that the landscape itself has become a technical object across art, industry, and the military. This project was supplemented and deepened by a graduate seminar of the same name, which was held in the fall of 2016.

WHY THIS COURSE?

Over the last century, we have produced a new kind of landscape – one put to scientific, high-tech industrial, artistic, and military uses. From massive arrays of radio telescopes to miles-long accelerators, thermonuclear weapons, and missile testing areas, the land itself has taken on a new complexion – altering its physical fabric and impacting the region’s economic and even metaphysical status. This trip was an opportunity to look at the colliding geographies of these territories through the alternating lenses of anthropology, history, ethnography, and science. Seminararians compared the industrial-scale scientific alteration of land to the postwar development of 1970s earthwork art – including Robert Smithson’s *Spiral Jetty*, Nancy Holt’s *Sun Tunnels* and Michael Heizer’s *Double Negative*.

On the expedition were five History of Science graduate students: Leah Aronowsky [research assistant], Juanis C. Becerra Sandoval, Angelica Marquez, Hannah Conway, and Brad Bolman. Assistant Professor Matthew Hersch and myself were the two faculty members on the trip. With a great deal of planning and a healthy dose of good fortune, we were able to coordinate our trip with a parallel course, “Landscape Experience,” to be held at MIT (in the History Theory Criticism program within the Department of Architecture). That course was led by Prof. Caroline Jones and Dr. Rebecca Uchill, a Mellon Foundation Postdoctoral Fellow with the Center for Art, Science and Technology at MIT. While our Harvard-based trip focused primarily on military-industrial sites with a secondary interest on the art history of earthwork constructions, the MIT course had it the other way around; their primary attention was to the land art, with secondary attention to the scientific-technical aspect. Together, we were around 20 scholars.

Our program was ambitious: we began in Salt Lake City, circumnavigated much of the Great Salt Lake, headed town toward Las Vegas, east to Albuquerque, south to southern New Mexico, north to Los Alamos and Santa Fe, and finally landed in Albuquerque – a path of over 2,000 miles.

Leah Aronowsky, 2016



HERE IS A SHORT-FORM SUMMARY OF OUR MAJOR ENGAGEMENTS:

Day 1:

Robert Smithson, *Spiral Jetty* (Great Salt Lake, Utah)

Nancy Holt, *Sun Tunnels* (Utah)

Day 2:

Michael Heizer, *Double Negative* (Mormon Mesa, Nevada)

Center for Land Use Interpretation (Wendover, Utah)

Day 3:

Hoover Dam (Nevada/Arizona)

Tribal Council Chambers Building, Navajo Nation (Window Rock, Arizona)

Day 4:

Trinity Site (within White Sands Missile Range, New Mexico)

Launch Complex 33 (within White Sands Missile Range)

Rocket Garden (within White Sands Missile Range)

Day 5:

Karl G. Jansky Very Large Array Radio Astronomy Observatory (near Socorro, New Mexico)

Day 6:

Rock Art, Bandelier National Park (White Rock, New Mexico)

Los Alamos Historical Society (walking tour)

Los Alamos National Park (just established)

Bradbury Science Museum (Los Alamos)

Day 7:

Various art installations in Santa Fe, including the contemporary art museum SITE (displaying a biennial show on arts in the contemporary Americas), the museum of contemporary Indian art, and a hybrid artist-collective/science/science-fiction entertainment complex “Meow Wolf.”

There are, in my view, three principal forms of knowledge captured by this kind of work:

SCOPE AND SCALE

Even though I have studied texts and photographs of many of these sites for decades, there is simply no way to convey, other than through physical presence, the scale of the 100-by-40 mile White Sands Missile Range; the number of launch sites, the Hermes rocket perched on the gantry of von Braun’s Launch Site-33, the Trinitite-strewn field in the desolate basin of Alamogordo, the feel of hiking through the earthworks in their isolated, high-desert spaces as the light and weather change. There is something significant in the tactile experience of walking the Hoover Dam, of seeing a Patriot missile lift off over the heads of grazing oryxes, or of clambering into the guts of an antennae perched on the 20-mile-long train rails of the Very Large Array.

CONTEXT AND INTERACTION

It is one thing to read about the Wendover Air Force Base, where, in 1945, Colonel Tibbets and his crew secretly prepared their mission against Hiroshima. It is another thing entirely to walk the once highly classified base, where some 20,000 people spent the last years of World War II. One sees in this half-abandoned space an eerily preserved landscape of the Second World War – and its current re-purposing into the art/military/sci-tech Center for Land Use Interpretation, complete with its “studios” hard against an active sniper-training range on one side, and a bomb depot on the other. Meeting with the co-founder and director of the Center, artist Matthew Coolidge, we asked about the boundaries of art and technologies of war and peace. We saw how the same landscape that prepared the first atomic war has now morphed into something radically different; the same airstrip where the Enola Gay bombers were readied now serves to fly in Midwesterners, shuttling them at discount prices into the massive casinos that stand on the hills above the old base. To understand the Los Alamos of the Cold War, it matters to see its current context: the highly-educated, well-off community that it has become. Even the iconic earthworks like the *Spiral Jetty* look radically different when one can see the spatial context, a context utterly omitted in photographs and descriptions.

It was a privilege for us to not only study the site of the July 1979 Church Rock uranium spill that so affected the Navajo Nation, but to be able to meet and talk at some length with a member of the Red Pond community who still lives in the irradiated area. We also spoke with Jonathan Perry of the Tribal Council, as they tried to negotiate settlements with both U.S. Federal Government and the not-always-harmonious groups within the Navajo Nation.

THE MOVABLE SEMINAR

The trip could not have been more intense. Each day we had numerous articles and chapters to read, each of which cast a different light on the day's events. Starting most days at 6 or 7 a.m., we used our bus and car trips to alternate with presentations by the faculty: Peter Galison, on the Manhattan Project; on the Buchenwald subcamp that produced Werner von Braun's V2s with slave labor, killing some 20,000 prisoners; and on the history of radio astronomy and array-based astronomy. Matt Hersch lectured on early rocketry (about which he is an expert), on the V2, and on the kinds of missiles represented at White Sands. Caroline Jones addressed the history of earthwork art. And finally, the graduate students, both from Harvard and MIT, presented on the Hoover Dam, and discussed (for example) the catastrophic radiation spill at the Church Rock uranium mine in 1979. We showed films, and argued out the politics, aesthetics, and technical history of the sites.



Matthew Hersch, 2016

COMMENTS FROM PARTICIPANTS

LEAH ARONOWSKY:

Before the "Technical Lands" trip to the American West, I thought of environmental scale as something that, with some gradation, largely fell into two categories: "vast," or "not vast." This trip challenged this dichotomy in a very profound way. Experiencing these humanmade landscapes - whether land art or missile ranges - taught me that even the most enormous of environments still contain elements of humanness, and that it's possible to locate a sense of self within them.

Michael Heizer's *Double Negative* (1970) is a perfect example. To read about *Double Negative*, or to experience it through photographs, a particular narrative inevitably emerges: that Heizer has played God, using dynamite to displace 244,000 tons of rock to create a literal canyon on the Mormon Mesa of southern Nevada. Implicit in this narrative is a particular statement about the hubris of American men circa 1970. Experienced in real-time, though, the narrative shifts: Heizer's manmade crater, while strikingly vast, is tempered by the incredible canyon of the Moapa Valley that immediately neighbors it to the east. The phenomenological experience does not so much refute the critique of *Double Negative* vis-à-vis American identity and gender - indeed, I would be loath to argue that the work contains any trace of sophisticated ideas about masculinity - but it certainly introduces nuance. The photos of the cavern emphasize its monumentality and depth; *Double Negative* appears to exist in the singular. In the field, though, the viewer realizes that *Double Negative* does not stand alone, but is inset in a natural formation whose scale *Double Negative* does not begin to approach.

I found myself having similar experiences at the monument marking the site of the Trinity Test, the Very Large Array radio astronomy antenna, and at several of the other land art installations we visited. As consumers of written scholarship, landscapes in the American West are positioned to us as historians as phenomena and entities that defy human comprehension. But when experienced in person, these environs become inextricable from their vast landscape context. Scale is, of course, always a question of relations, but experiencing these sites in the flesh allows the viewer to make the scalar assessment herself, rather than rely on outside sources.

This trip has made me rethink many of the categories I previously took as givens in environmental history scholarship: "scale," "remoteness," "emptiness," "vastness," even "the West." Going forward, I want to think about techniques and strategies for conveying this sense that many of the analytics we use as historians in fact exist in a state of flux. They are categories whose boundaries are always forged in relation to something or someone, whether a viewer or a historian.

Leah Aronowsky, 2016



ANGELICA MÁRQUEZ OSUNA:

The field trip “Technical Lands” was an enriching experience that allowed me to explore new approaches in history of science, technology, art and environment. As an incoming Ph.D. student, this trip was an extremely useful activity for my academic formation, because it provided a comprehensive view of specific places and periods of U.S. history that invite one to rethink traditional historical perspectives.

One of the most significant activities during this week was the visit to the Navajo Nation Tribal Council, where activists from the community shared their claims and political points of view concerning the Church Rock uranium mill spill which occurred in 1979.

This field trip also provided elements to think critically about controversies and problems, contrasting the assigned readings with the narrative and practices of experts in situ. The visit to Trinity Site and to the White Sands Missile Range, for example, allowed me to reflect the problem through the materiality of the landscape because I experienced the order, regulations and rules that characterized those places. In addition, by exploring the VLA Center and Los Alamos I realized how science and technology become critical part of the public history.

This experience also contributed to my personal formation because I had the opportunity to learn from Prof. Peter Galison, who, as a historian of science, has interesting and useful approaches to different topics in the field and practice. I was able to experience the engagement with diverse groups and social actors, such as scientists, activists, tour guides and other historians. Thus, the expeditions expanded my academic view beyond the classroom since I observed the different tools that we need in order to empathize with people.

The trip was also an excellent point of departure to socialize and share discussions with other students that have my similar interests. I am especially interested in exploring the transformations of landscapes from the approach of environmental history, thus after the field trip I realized how the study of such transformations are closely related to the history of physics and history of art.



Finally, this fieldtrip is linked to the seminar “Technical Lands” that I am taking this semester. As an international student, I think that the expedition in conjunction with the seminar is a stimulating opportunity. After exploring the environment, technology and culture of the Southwest, I realized that I have more elements to understand and analyze the complexity of the U.S. history, and hence, to expand and enrich the perspectives of my own research.

JUANIS C. BECERRA SANDOVAL:

From the window seat of a large bus filled with restless graduate students, the U.S. Southwest landscape seems vast and inescapable. The flat mesas with their desert redness and scarce bushes are, at the very least, disorienting. The sense of distance, time, and scale is completely disturbed, leaving the viewer quantitatively lost, dependent only on her or his senses to interpret the world outside the bus. Most of the time there is not much to absorb, but every hundred miles or so, in the midst of this seeming stillness and repetitiveness, landscape artworks, missile ranges, nuclear test sites, and radio astronomy observatories make their appearance.

For a student reading a collection of articles the connection between these sites is not immediately obvious. The connection was most definitely not obvious for me. Going through the articles in the Google Reader we received prior to the trip was puzzling. I couldn't help but ask myself: what do Robert Smithson, Nancy Holt, and Michael Heizer have to do with the U.S. V2 Rockets and Wernher von Braun? How is the Navajo Reservation in Window Rock connected to the White Sands Missile Range? My first attempt to resolve these questions resulted in failure. Reading articles simply did not give me enough information. In fact, grasping the complexity of these technical landscapes only became possible after physically stepping on the grounds of Utah, Nevada, Arizona, and New Mexico.

There are many reasons why this embodied experience was such a great complement to classroom discussions and reading assignments, the following are just a few of the benefits that were particularly striking for me:

Being able to listen to the public narrative given by tourist guides and experts at the sites. Most of the people who gave us tours of the facilities have never published a written record; hence, their stories and the historical narrative they used was something that we had access to only because we were able to visit the sites. These spoken narratives were useful because they included unpublished stories, such as Millers' account of the VLA's use of eBay to acquire crucial equipment during times of economic hardship. They were also useful because it allowed us to engage with the narrative that is made known to the majority of the U.S. population, which has elements that are quite different from the narrative that is shared among historians of science.

Engaging in a more personal way with the contradictory relationship between the U.S. and Native populations. One of the most interesting and meaningful moments of the field trip was the visit to the Window Rock Reservation, where we were received by the Navajo people who are working on resolving the problems brought to their community because of uranium mining in nearby areas. Seeing the facial expressions and the body language of the Navajo was extremely evocative; the humility and honesty with which they discussed the past, present, and future of their community brought tears to my eyes. Being in the same room with them and hearing their concerns made such an impression that now, when

someone discusses mineral mining, nuclear waste, and nuclear testing, the faces of the Navajo people come immediately to mind. I made a personal connection with them that will forever accompany me. I believe that from now on, I will think more inclusively about the impacts of science and technology in the environment and lives of native populations.

Being able to ask more pointed questions about a historical moment or a technical site. Before going to the field trip I had never asked myself what had happened to the soil after the Trinity Test in 1945. My focus on the history of the Trinity Test had always been based on the accounts of the physicists who had seen the atomic bomb explode for the first time. I was concerned about what the physicists had felt before, during and after the explosion. I was also concerned about the effects of the test on the atmosphere and the animals surrounding the area. Seeing and holding pieces of Trinitite, a green, radiative material formed by the crystallization of the sand in the site, made me more aware of the impact of the test on the soil and the vegetation of the area. The fact that we visited so many nearby places during the same trip also made me wonder about the effects of the test in other locations. I wondered how the mushroom cloud was seen and felt from Truth or Consequences or from Albuquerque. In other words, I started thinking about nuclear explosions outside the boundaries of their immediate landscape.

Contrasting the grandiose nature of some of these sites and the day-to-day experience of the people who work at the sites. The people who work at these sites bring a different perspective to the landscape. For them the Rocket Park, the missile launch site, the Los Alamos Laboratory, and the humongous, LEGO-like antennas of the VLA are part of everyday life. In a way, these people make the extraordinary seem ordinary. For a historian of science this is an incredibly useful and helpful realization. When we study the history of the engineers, the technicians, the janitors, the scientists, the gardeners, the policemen who work at these sites, we often forget that for many of them their work is their livelihood – we often forget that these people were and are like us: concerned with paying the bills, with eating their meals, and doing the best they can to do their jobs.

Comprehending that complexity and incongruence is part of the landscape. I always tended to assume that the landscape had to be consistent and logical in its use. This field trip demonstrated how wrong I was in making this assumption. The landscape does not follow logical rules; instead it is the result of a process of mediation between military, economic, political, artistic, environmental, and cultural constraints. The use of a former military airport by hundreds of people who are interested in spending a weekend or a couple of days in a casino located right next to the Center for Land Use and Interpretation is only one example of this phenomenon. Choosing a site for a military base, a test site, or an artwork is an exceedingly complicated tug of war, played by far too many teams. The result of this interplay of forces is a multiplicity of sites where art, war, technology, and everyday life become intertwined.

These are just some reflections and thoughts that I have managed to gather immediately upon returning from the field trip. I am certain that time will bring further thoughts and ideas about how this field trip has changed and will continue to change my scholarship. I am immensely grateful for this opportunity, especially because it is the first time that I have been able to visit an actual historical site as part of an educational experience. Hopefully these kinds of learning experiences will continue to receive the support that they deserve and that students will continue to find these opportunities interesting and engaging.



**BRAD BOLMAN:**

On a map, the White Sands Missile Range has the appearance of a fractured rectangle, stretching 3200 miles across New Mexico. Satellite imagery offers little perspective on the range (like other similar government sites, it is blank on Google Earth), and the images that exist are few and far between.

On the morning of our arrival, Japanese Patriot missiles were being tested; a bulwark against a rising China and the fear of unpredictable North Korean aggression. As we entered the gates on our way to the Trinity site, a short burst of flame was the only sign of the Patriot's flight. At Trinity, where the first atomic bomb was tested, there are two markers of the event: a large black obelisk made from local rock and, scattered across the ground, Trinitite, a luminescent green glass created by the explosion. Holding a piece in my hand with the dark monument standing a few feet away, signs of an event that more thoroughly transformed the twentieth century than nearly any other comparable techno-scientific discovery, I felt a sense of profound understanding that I still find difficult to reduce to words. I have read dozens of books about the War and the Bomb, but I had never before felt that history in my body: in the warmth of the sun that Oppenheimer also felt, the silence of the wide plains, a wind that seemed wary of disturbing us. And as we continued to drive, White Sands struck me more with a startling beauty: mesas and mountains in every direction, hewn perhaps by manmade weapons or deep geological time, flecked occasionally by shining fragments of missile targets, vast stretches of shrubs and grassland, cactuses that reach skyward like men praying, or surrendering.

There are, in White Sands, thousands of African Oryx, introduced long ago by the Nevada government to generate hunting revenues but too perfectly adapted to the terrain. A dozen or so stopped by the side of the road and watched as our caravan barreled through the otherwise empty roads and two F-16 fighter jets practiced dogfighting tactics between the ridges.

At the end of the road are stunning white, gypsum sands and the only intact V2 rocket in the world, housed in a small, dark room near the White Sands museum. Our guide, Darren, informed us that this liquid-fueled rocket provided particularly acute challenges for its Nazi manufacturers: the alcohol used for fuel too often found its way into the rocketeers.

But even beyond the incredible sense of place and history and space generated by every stop of the trip, it was the opportunity to talk with Kirk, with the Park Ranger in charge of developing the Los Alamos National Park site, with the curator of the Los Alamos Historical Museum and others like them that continued to provide unimaginably rich insight into the production and preservation of history, military or otherwise. At every step, these individuals working with varied budgets and disparate circumstances were grappling with the challenge of telling the history of places that were not always open to the public eye or even accessible to the guides themselves. Their commentary on the work of history, even more than the history itself, the kind of insight that is literally inaccessible in books or internet sources, thoroughly deepened my own thinking about how to do the work of history, and produced a respect for the individuals who work to make that writing possible.

It was a commonplace on the trip for the students to turn to each other and remark that this was one of the most incredible experiences any of us had ever had: sitting atop one of the dishes of the Very Large Array, enormous white radio telescopes that helped pinpoint the existence of water on Mars while a former director explained the challenges of building and upgrading these systems is only the first of many to

come to mind as I fly back to Boston from Santa Fe. I could say the same of the jaw-dropping immensity of Robert Smithson's *Spiral Jetty*, nestled into the white sand of Utah's Great Salt Lake, licked by the lake's otherworldly pink water, or the fields of the Wendover airfields where the pilots who dropped the atomic bomb on Japan were trained and where Matthew Coolidge's Center for Land Use Interpretation turns a critical eye to the terrain that surrounds it, or even – and particularly – of hearing activists and lawmakers from the Navajo Nation explain the colossal task of contesting a violent past and present of uranium extraction.

When we told the head of the Very Large Array about our visit to Trinity the previous day, he was stunned: the site is, after all, open only two times a year, and we were there for neither. All we could muster in response was that we were lucky enough to go on the third. The message was the same from many of the scientists and guides we spoke to, even as each one continued to add new perspectives on our academic studies and methods.

I am deeply grateful to have had the opportunity to take this trip, to have brilliant classmates and professors there at each turn to discuss the implications of everything we saw. There are a great many privileges that come with studying at Harvard but this trip felt like something much greater: a kind of aesthetic, educational and experiential journey that few other people of any kind will ever be fortunate enough to experience.

HANNAH CONWAY:

The opportunity found in out-of-classroom learning experiences for graduate students is truly invaluable. While our institutions provide us with outstanding communities of scholars and the benefits of knowledge exchange within those settings as well as within the classroom, knowledge derived from lectures, readings, and discussions will invariably require enrichment in some form. For the study of the complicated interplay between technology, science, and the pieces of land these spaces and structures occupy an exploration in the field is arguably one of the most important ways knowledge about these relationships can be enriched and more deeply understood within the context of scholarship and within the human and natural worlds in which they exist.

In the case of this particular trip, the ability to blend an interdisciplinary approach to these spaces by comingling our historically minded group with the more artistically minded group from MIT provided an excellent space for intellectual exchange and discussion and served to strengthen the inter-institutional ties between ourselves, these students and post-docs. Having studied two of the land art works previously in art classes, I had certainly found them interesting pieces, but the idea of actually going to visit them was far from my mind. Further, the connections between these art pieces and the later technical spaces we visited created an excellent engagement between art and science and technology that is often overlooked or simply dismissed as an unnecessary bridge to build. In particular, the question of land use was deeply interesting to me: what does it mean to take a piece of land and create an artwork either on or within that land that then serves a strictly aesthetic purpose as opposed to the use of land for defined programs of research and design or for infrastructure? How does a piece like Holt's *Sun Tunnels* become more nuanced when we place the large concrete cylinders, which she uses to mark the passage

of the sun and the location of constellation, mentally alongside the banal usage of these structures in everyday construction projects? Can we draw boundaries between art installations and infrastructure installations or do we need to find ways to blur these distinctions?

There is also the benefit that can be gained from visiting these places and feeling the weight of the stories they tell. You can read about the Manhattan Project but actually standing at the Trinity Site, with the obelisk of black volcanic rock marking the place and moment in which the United States (and, arguably, the world) entered the nuclear age is a completely different form of tangible experience. The sand is underfoot, littered with the bits of Trinitite fused together from the sand and the sheer power of the bomb. Wildflowers surround the black monument, in bloom at our particular time of visit, a visible contradiction to the power of science and technology that once irradiated the land, the technological sublime tempered by small, purple buds. The Very Large Array is also a well-known (within the science and tech community) collection of impressive machinery, but the awe these beautiful machines inspire when standing along the railroad tracks that cross the array, or when seated inside the bowl of the antenna, blinded by the reflection of the sun off the ultra-white surface and witnessing the sharp line where white becomes the deep blue of New Mexico sky, cannot truly be understood from a simple image or a piece of text. It is an understanding that must be lived.

Matthew Hirsch, 2016



Perhaps most importantly, however, is the interaction our group was able to have with the humans that live and work within these spaces and amongst these machines. The meeting our group was able to have with representatives from the Navajo Nation and Red Water Road Pond Community (a group of Navajo activists affected by the Church Rock mining spill) was a particularly powerful moment for most of the members of the trip as well as myself. Again, you can read articles and reports of the effects of both uranium mining and the spill of 1979 on the people and land of the Navajo Nation, but speaking face to face with affected members in an intimate setting in their seat of legislative and governmental power is truly, to allow a moment of cliché, a once in a lifetime opportunity. The inclusion of peoples, of human elements, in technological narratives is always valuable but to have a narrative that is often overlooked, disrespected, or ignored reintroduced to these places and sites creates better histories. Sometimes we have to rack focus to get a better picture.

In sum, I am incredibly grateful to have been afforded this opportunity by the University and the grant that allowed it to be so wonderfully realized. My interest in the relationship between the state and technological and scientific projects made this trip an obvious choice for me, but the ways that my understanding of how webs of narratives surrounding these structures, laws, policies, and spaces has added a new analytical depth to the way I historically approach and interpret them. I am excited and curious to see how the experiences of the trip come into play during the rest of the course and how this in the field learning expands and interacts with a traditional in-classroom setting.

MATTHEW HERSCH, ASSISTANT PROFESSOR DHS:

As an Assistant Professor in the Department of the History of Science who specializes in aerospace technologies, I was delighted when Professor Galison invited me to join the Technical Lands Field trip as an instructor. In my course work, which includes lecture and seminar offerings on rocketry and space exploration, military technologies, and computing, it is often difficult to illustrate technical and historical lessons without the presence of the technologies themselves. Images, film, or digital materials cannot adequately convey the size and intricacy of rocket components, or convey the experience of using them. Often, essential lessons about the evolution of technologies require comparative evaluation. There may be no way to convey the isolation and loneliness of a yet site, the land requirements for missile testing, and the risks that require mitigation.

During the Technical Lands field trip, I was fortunate to be able to teach graduate students about rocketry in the presence of actual rockets, at ATK, Wendover AAF, and White Sands Missile Range. Using real-life examples, we could discuss their similarities and the complex systems that enable their operation. These visits included the opportunity to view, teach about, and place in historical context the operation of a variety of rocketry systems, from infantry weapons to space launchers and an historic launch gantry and block house. With the help of experienced guides, we received an insider's perspective, and were offered access to archives and artifacts not yet available for public viewing.

The chance to view the Trinity Test Site and the location of the Manhattan Project's "Site Y" in Los Alamos will also prove invaluable in my Fall teaching, which will discuss nuclear weapons and their development in detail. And the opportunity to visit, tour, and even climb a dish antenna of the Very

Large Array with the facility's former director illuminated ideas of "big science" that I had experienced only through texts that never quite communicated the complexities of this critical practice. I doubt that the craft knowledge of radio astronomy I learned there could be obtained any other way.

The Technical Lands field trip has already proven valuable to my own research on the history of the Space Shuttle, fostering connections with historians and archivists throughout our visit. Its benefits for history of science pedagogy and graduate education, though, are incalculable.



Matthew Hersch, 2016

TRIP 2: CONSERVATION, EMPIRE AND DARWIN IN ECUADOR AND GALAPAGOS, MAY 26-JUNE 2 2017

Prof. Janet Browne and HUCE Fellow Laura Martin
Research Assistant Alicia De Maio

This was the second History Beyond the Classroom trip for graduate students of the department. Much of the trip's organization and planning was carried out by Alicia DeMaio during the previous semester. The 2017 trip was led by Prof. Janet Browne and Harvard University Center for the Environment Fellow Laura Martin. Students were Mashaal Sohail, Alyssa Botelho, Lisa Haushofer, Kit Heintzman, Gustave Lester, Miriam Rich, Aaron Van Neste, Yvan Prkachin, and research assistant Alicia DeMaio.

Our two primary goals for the trip were to engage with the circumstances and historical context of the travels of Charles Darwin and Alexander von Humboldt in Ecuador, and to explore conservation management and the consequences of ecotourism in fragile and historically significant areas. A deeper aim was to explore ways of using landscape as a form of 'text,' or living historical 'document,' to illuminate our research as historians of science. We felt that these imaginative teaching aims were true to the intellectual values of our donor and would have greatly interested him.

Students visited Quito, where they learned about the pre-colonial history of Ecuador and climbed Mount Cotopaxi in Alexander von Humboldt's footsteps. They then took a 4-day boat expedition in the Galapagos Islands, where they grappled with the scientific mythologies and commercial tourism focused on Charles Darwin's visit in 1836, while also coming to understand the intense management procedures to facilitate visitor expectations. The group learned about conservation techniques on site. The trip ended with a tour of an upland breeding reserve for giant tortoises. Before the trip, there were 4 days of preparation in which students engaged with texts and films that would prepare them intellectually for the expedition. Throughout they were encouraged to question what might be "natural."

Lisa Haushofer, 2017



We flew almost 3000 miles to Quito, Ecuador, before boarding another 865-mile flight to the Galapagos Islands.

The itinerary was to first explore colonial history in Quito, then travel to Mount Cotopaxi (climbed by Alexander von Humboldt in 1802), and study the ecology, vegetation zones, and geology; and second, to take a four-day cruise in the Galapagos Islands, in order to learn about Darwin's time there and the subsequent history of land management up to the present day, particularly in relation to invasive species. A cruise (rather than a land-based stay) was intentionally chosen so that students could experience something of the nineteenth-century marine mode of travel. The ship was our moving home and we landed on each island in turn, in imitation of Darwin.

During our travels, we gave a daily reportage assignment to each student (including photography, blog posts and one documentary movie). We reviewed the day's findings in an informal seminar each evening after dinner. It was an experimental and participatory way of teaching that we all found illuminating. An incidental benefit was that some of the other guests on our boat became engaged with our project and wished to know more, leading to stimulating and friendly exchanges.

Lisa Haushofer, 2017

QUITO

We began our trip with a three-day stay in the capital city of Quito, learning about the history and culture of Ecuador. We took a walking tour of the historic city center, rode the Teleferico cable cars up Pichincha volcano, met a pair of guanacos, visited the botanical garden and ethnographic museum, and climbed Cotopaxi volcano, following in Humboldt's footsteps. Humboldt's "Essay on the Geography of Plants," which we had read, records his theories regarding how alpine vegetation changes as one ascends a mountain. Spending time thinking about the Ecuador that Humboldt encountered - and how he wrote about those encounters - was inspiring, not least because of Humboldt's influence on Darwin's nature writing. We also recognized, on the ground, the importance of thinking globally about science and the problematic (and changing) role of European dominance - both then and now.



Climbing Mount Cotopaxi was extremely strenuous, with high winds swirling gravel into the air, and elevation changes leaving many of the group gasping for breath as they pushed higher and higher. Our aim was the climbers' hut at 13,000 feet (nearly 4000 meters). The return downhill was a little easier, and we arrived back at our van triumphant and exhausted. Once we were all reassembled, we had a traditionally huge climbers' lunch.

Even though we only had a few days in Quito we saw a great deal and learned about the colonial history—not merely the Spanish but also earlier conquests by the Incas—and the indigenous peoples of Ecuador. A trip to the Ethnographic Museum was fascinating. We also went on a bus to the edifice at the top of the central mountain of Quito, that comprises the Monument to the Equator (Monumento del Ecuador), a modernist sculpture signifying the global south, and affording tremendous views of the urban expansion of the region. The view from the top of the teleferique were similarly stupendous, especially with an alpaca hoping to eat our packed lunches.

GALAPAGOS ISLANDS

On our four-day cruise in the Galapagos, we explored a variety of terrains and met a wide array of plant and animal life. By visiting four islands - Santa Cruz, Genovese, Rabida, and Santiago (the latter of which Darwin also visited) - we witnessed firsthand the natural diversity of Galapagos. We walked on red sand beaches, rocky cliffs, and lava flows. We saw a staggering variety of birds, including three types of boobies, two types of frigate bird (a flock of which accompanied our ship), flamingoes, and at least three types of finches. The animals were remarkably unafraid of us and we each experienced some astonishing moments of closeness with nature. We noted that the finches all look much the same, and came back with a new understanding of the difficulty Darwin had with distinguishing them from one another. We also saw the famed Galapagos tortoises, sea turtles, lava lizards, marine and land iguanas, sea lions, a school of dolphins, and several rays and fishes - along with the opuntia cactus and palo santo vegetation.

Alyssa Botelho, 2017



Astounded by both the ecological diversity and the proximity of the animals, we took time in the evenings to compare our experiences with Darwin's. Some of us even struggled with the same seasickness that plagued Darwin nearly 200 years ago. The landscapes we encountered are being restored to an ideal that sometimes the very ground betrayed - we walked on lava flows that did not exist in Darwin's time. While our experience necessarily had a managed quality to it, we were reminded daily of the unpredictability of nature; we were never exactly sure what we would see or how the animals would behave.

Our cruise ship was small and exciting in itself: to be sailing through the archipelago in the same way that Darwin and other travelers had visited the islands truly added to the experience. We were lucky to have our very own Ecuadorian naturalist-guide with us on the ship who took us on excursions in an inflatable twice a day to different places. Every day began with a hike across varied terrain, much of it comprised of recent lava flows, where we noted a few intrepid cacti. By the coast we encountered the famous black marine iguanas just as Darwin described them. Other areas that had more water seemed, by contrast, quite lush. The tortoises that we saw were on a special conservation farm and were truly giant. These treks gave us a vivid sense of what it must have been like historically to collect and explore this and similar landscapes.

Janet Browne, 2017

Janet Browne, 2017





There were so many highlights to remember. One was to be accompanied by a large school of dolphins playing in the bow wave of the ship. Another was to realize that the large sea turtles glimmered up from below to look at us in our inflatable, a reversal of the usual human-animal interaction. We also visited the Charles Darwin Research Station that maintains a breeding station for tortoises from different island. One afternoon we went snorkeling to encounter the Galapagos underwater marine conservation park and were discovered by baby seals who wanted to play.

The spontaneity, and the sense of wonder these natural interactions provoked in us, resonated with our reading of Darwin and Humboldt. We understood how difficult it was for Darwin to come to any conclusions about the natural history of the Galapagos, and how skilled Humboldt needed to be to articulate his zones of botanical habitation. Furthermore, we were impressed by the complex management and infrastructures that allow tourists to encounter the Galapagos as seemingly pristine lands. We are incredibly grateful for this extraordinary opportunity, which enriched each of us with inspiration and understanding.

Janet Browne, 2017



TRIP 3: LADAKH, INDIA, JULY 14-28 2018

Prof. Naomi Oreskes

Research Assistant: Hannah Conway

INTRODUCTION

The third History Beyond the Classroom trip was, at the time, the most ambitious and remote trip thus far. Our group was eight people in total – faculty leader Naomi Oreskes, HUCE fellow and lecturer in the History of Science Evan Hepler-Smith, graduate students Hannah Conway, Erik Baker, Jacob Moses, Miriam Rich, and Gustave Lester, and executive director and founder of Utah Clean Energy Sarah Wright. Together, we traveled by plane, car, foot, and horseback for two weeks into the Lgnak valley of northern India. Our purposes truly took us beyond the classroom and beyond a traditional scholarly experience. By working with the social enterprise Global Himalayan Expedition (GHE), our group not only engaged in an adventure and wonderful exchange of culture, stories, and knowledge with our local guides and hosts, but also brought solar-powered electricity to the remote village of Thangso and its residents.

Our journey into Ladakh began at a coat check in Davos, Switzerland in 2016. While checking their coats at a meeting of the World Economic Forum, Naomi and GHE team leader, Jaideep Bansal introduced themselves and began talking about the work GHE was doing to bring remote villages electricity through sustainable solar micro-grids. Their model combined three of Naomi’s favorite things: adventurous world travel, combatting global climate change, and empowering women. The two kept in touch. When the opportunity arose to lead a group of students on a once-in-a-lifetime trip that would explore issues of science and technology beyond the classroom, Naomi knew exactly who to call.

Global Himalayan Expedition was founded in 2013 by Paras Loomba. They seek to provide innovative solutions to energy poverty by creating “tangible, social, sustainable infrastructure.” The group works on a model they call “impact tourism,” wherein volunteers from around the world come together to travel to a remote village, transport equipment, and install the micro grids. The tourism aspect of the model serves a purpose beyond the additional funds and helping hands it provides: it brings tourism to the area, which generates revenue for the locals through homestays. It also creates what Jaideep and Paras call “change-makers:” participants who come to GHE for the experience and leave inspired to take the GHE ethos home with them. On the technical side, the group focuses on three initiatives: energy access through DC solar micro-grids, education access through sustainable computer labs installed in remote, rural schools, and homestays through the provision of a platform available to the villagers for bringing tourists into the area. They also train local women as engineers, both to assist the group, and to empower them to start their own careers. (If you would like more information, we encourage you to visit their website: <http://www.ghe.co.in/index.html>.)

The ambition to take a group of graduate students into the far reaches of the Himalaya began in earnest during the spring semester of 2018. Naomi, an experienced trekker, briefed prospective trip participants on the risks involved in such a strenuous adventure. When the final group was set, we began training – many taking advantage of the hiking opportunities in the greater New England area, while Naomi worked to heal a broken ankle. The group also engaged with a list of texts and films on a wide range of subjects that would prepare them intellectually for the expedition. The materials included examinations of recent

anthropologies of infrastructure, critiques of renewable energy sources and ideas of “sustainability” and “resilience,” the political history of the Ladakh region and the partition of India (the border of Jammu and Kashmir is still contested with Pakistan), and social and cultural history of the region and rural southeast Asia more broadly. We held webinars with GHE to preview our finalized itinerary for the two-week journey and familiarize ourselves with the route we would take through the mountains. Long gear lists were circulated and Memorial Day sales on hiking and trekking equipment were taken advantage of. Passports were renewed and visas secured. A little before midnight on July 14, 2018 our group met at the Boston Logan airport to begin the 24-hour journey to Leh, India.



Evan Hepler-Smith, 2018

THE TRIP

Our itinerary was for a 13-day stay, with travel on 10 of our days. After spending most of the first day napping and acclimatizing to the high altitude of Leh at 11,500 feet, our group gathered for dinner and a viewing of the movie “Jungwa: The Broken Balance,” about the devastating 2010 mudslides that tore through Leh city, and the accompanying increase of dramatic weather patterns in the region due to climate change. In the middle of the film, we were surprised by a visit from Sonam Dorjey, the councilor for the village of Lingshed, who spoke to us about the education-related challenges in the rural areas of Ladakh. He told us that his hope for the region was to have equitable access to resources that would encourage young people who leave to further their educations to then return to the villages as educators themselves. The challenge of finding ways to bring young, educated people back to the remote villages they are from in hopes of creating sustainable futures for these areas was a theme we encountered many times throughout the trip, and one that many rural areas worldwide struggle to address.

On the second day, we met several more people from the GHE team and were given a presentation from Paras and Jaideep which outlined more extensively their model and the technical aspects of the system we would be working with. The presentation included two women who had been trained through the program, who spoke with us about their experiences related to both gender in the region and to their training and work in the villages. We were also introduced to a film maker working with GHE to produce media and create awareness about the issues the region faces. Following the presentation and another nap, our group headed out to explore the local sites: an Indian Army Hall of Fame Museum, the Shanti Stupa, and the Leh market.



Our next two days were spent driving in a contracted bus driven by Sonam Dorjey, a local of a village along our route in Zaskar. On the first day, we traveled for about six hours from Leh to Kargil. On the following day, we continued from Kargil into the Zaskar region, stopping for the evening in Padum after about 10 more hours of driving. Our travel on the first day was on mountainous but well-paved roads. On the second day, we moved to narrower dirt roads that wound through mountain passes and valleys, crossing two glaciers and stopping along the way at roadside stalls for plenty of tea. Along the way, we encountered power lines installed by the government, from which the transmission lines had been stolen – scarecrow poles dangling loose wires from their arms. Jaideep talked to our group about government initiatives to bring power to these areas, and of the growing push for better access to more sustainable and reliable sources of energy like solar and hydro. We also encountered local flora and fauna on the drive: wild roses and the ever-present local cows, goats, and horses stood relatively unbothered by the roadside. Marmots and wolves also made appearances. Our group was particularly taken with the marmots and their run-hop gait which looks like a combination of both movements done poorly. Sadly, no one managed to take a decent marmot picture.

After a night in Padum, our group set off on the last leg of our drive. Along the way, we were told there would be a surprise, and a few hours into our drive we arrived at the Jamyang Ling Model School in Raru, Zaskar where we were greeted by the students and faculty. GHE had been working to set up a computer lab for the institution – running seven energy-efficient DC computers and a smart TV from a micro solar grid. They also established a closed WIFI network that included TED talks, all of Wikipedia, and state-curated educational material for the school to use. We were there to see the inauguration of the system, and students excitedly waited for the computers to come on. True to form, the internet connection took a moment of tweaking, but soon we had all the computers online and running, and the students began excitedly searching the internet. Some looked up their home region, Zaskar. Others searched for Boston and Harvard (after a nudge from some members of our group). Some googled “Naomi Oreskes.” A group of girls from the school gathered around one computer to watch a series of videos on how to turn recycled materials into toys.

After seeing the new computer lab, we had tea in the Headmistress’s office, where she discussed what the technology meant for her school and its students. The school was established in 1994 by a German non-profit organization, which continues to provide its funding through donations. Administrative duties are overseen by the Raru village committee. Both the 94 students and the faculty are housed in an on-site hostel, as many of them live several days trekking distance from the school in the remote areas of the Zaskar region.

School is in session from March to October; travel during winter months can be difficult. Harsh weather conditions effectively cut off access to travel routes for many of the villages, leaving the frozen Zaskar river as the only accessible route in or out of the region. While the school is private, it is recognized by the Jammu and Kashmir board of education and operates under state curriculum as an “English Medium school,” with textbooks in English provided by the state. Students at the school have lessons in English, math, science, geography, social studies, history, civics, Hindi, Urdu, and Bodhi (Tibetan language and philosophy), as well as extracurriculars such as music and games. The school provides education for students up to year 8, after which many transfer to a high-school level school in Jammu. From there, they can apply to universities after year 12. One of our guides, Tenzin Chongor, was an alumnus of the school.

We then loaded back onto our bus and drove to the literal end of the road. From there, our crew unloaded our gear and carried it down from the mountain road, across the “dancing bridge,” and to horses waiting on the other side. The horses and their handlers were from Thangso, and accompanied us tirelessly throughout our four days of trekking. Our group followed the gear down to the river, where we were hooked into a safety line and led one by one across the bridge. Once on the other side, we started our trek into the Lugnak and on to Thangso. We camped in the village of Yal our first night, then continued on the next day. Our trekking leader, Konchok Thinles, expertly navigated our group along the narrow mountain passes and down into grassy valleys, while regaling us with stories about bear hunting and searching for wreckage of WWII war planes with the British military in Arunachal Pradesh, another state in India.

Upon our arrival in Thangso, we were greeted by a large group of people from the village with hot tea and snacks. Everyone shook our hands and offered us the traditional Ladakhi “*Julley!*” greeting and Khataks. Our last day of trekking had been cold and a little wet, and the warm welcome was greatly appreciated. Children from the village were excited to meet us and the women, dressed in stunning handmade ceremonial clothes and headdresses, danced and sang. During our time in the village we stayed with families who run homestays for trekkers. It was a great opportunity to appreciate the life of the village and to get to know our hosts.

The next morning was electrification day. Over breakfast, we met with our engineers – Stanzin Gurment and Shakir Hussain – who had arrived ahead of us and began the process of electrification in the village. Each house was outfitted with either an independent or shared DC solar micro-grid, with efficient DC LED bulbs in each room. Our main jobs were to finish installation of the bulbs in several houses, including the ones we were staying in, and then install the solar panels on the roofs. We were divided into two teams; each team went with an engineer and a guide, while the homeowners showed us where they wanted their bulbs placed. After the bulb holders were secured, we went with the engineer to the roof, where they spoke with the homeowners about the orientation of the sun during different times of year to ensure optimum placement of the panel. After each installation, we had tea with the homeowners and their families before moving on to the next house.

We were surprised to find that several of the homes we worked in already had partial electrification – either independently purchased by the homeowners or provided in the past by another NGO. Many of the previously installed panels were inoperable, and the bulbs were inefficient compact fluorescents. GHE seeks to differentiate itself from other NGOs working on electrification in these rural areas in several ways. One is by distributing grid access equally to all homes and by ensuring that the grids – as well as the lights, televisions, and satellites the users in the village hook into them – are as efficient as possible. A second is by establishing a fund for each village that works with GHE, which is meant to ensure there is money to repair any damaged parts down the line. Once the fund is in place, representatives for the village get in touch with GHE through its employees or affiliates that operate throughout the region. GHE then organizes an expedition to come and complete the work. GHE also differentiates itself by working closely with people that live in or frequent the area and can report to the engineers when repairs or new parts are needed, or when new villages want to enroll for electrification. The people that we visited with while installing the grid seemed optimistic that this model would work well for them into the future and were excited to have us working with them in their homes.



glimpse of the Dalai Lama's entourage as they left the village (we missed them), and to have the first of two birthday celebrations for Hannah! Then we loaded onto our bus and set off on the six-hour drive to the Rangdum monastery, where we would be camping for the night. Along the way, we were pleasantly surprised when our bus abruptly pulled over and we were greeted by our driver's mom and sisters, who served us mid-morning tea on the side of the road!

Rangdum sits on a high hill at the center of three valleys. Our host and historian from the monastery, Lama Tseting Tundup, told us of its founding – which included a blessing from the king of Leh in the 17th century – and of how the monks there have benefitted from the electricity GHE provided them a few years prior. (When asked if there were any disadvantages to having electricity, our host laughed.) We visited their Gonpa, as well as a small museum on the property that houses artifacts from the monastery's founding and religious iconography. The following morning, members of our group woke early (from our lovely 'glamping'-style tents provided on the property) to join the monks in their prayers. The courtyard was already lively with women cooking and drinking tea.



After prayer, we had breakfast and then set out for Kargil. When we arrived in the town, we found we had crossed paths with the Dalai Lama once again, passing a heavy security outfit stationed outside of a gated hotel. We rested, ate dinner, and had good debriefing conversation with Jaideep and our group in the hotel's courtyard. Another surprise guest joined us, Tenzin Sonam, the councilor for the Lughnak valley. He spoke to us about his support for GHE and their work, as a politician who focused on accessibility and energy resources in the rural area. He also spoke of other needs he hoped to address in the future: education, computer access in every village, and expanding the road network. He then had to leave to join other government officials meeting with His Holiness, and offered to try his best to arrange a time for us to meet him before we left. Just before bed, Jaideep knocked on our doors and told us to be ready at 5:30 the next morning.

We gathered in the early dawn in the hotel's courtyard, and loaded into our bus to head back to the gated hotel we had passed the night before. When we arrived at the hotel where His Holiness was staying, local Buddhists in traditional dress gathered around the gates while the guards attempted to keep us all in neat lines. Tenzin Sonam came out to greet us, and we and the waiting locals were taken into the courtyard and organized into groups on the lawn. After a period of waiting, His Holiness emerged from the hotel. There was quite a commotion, as the gathered throng craned their necks to catch a glimpse, and we were instructed to wait in a particular place. And then another place. And then another. Suddenly, he was there with us. Tenzin Sonam explained to him who we were and why we were there, as we tried to hold our position around His Holiness while others nudged in to get closer. When His Holiness understood why we had come to Ladakh, he took Professor Oreskes's hand, turned to her and said "thank you," and our photo was taken. And then it was over. We had met the Dalai Lama. And he had thanked us.

We returned to the hotel in an oxymoronic state of sleepy excitement, and packed up for our last day on the road. Along the way, we stopped at the lovely family home and tea house of our dedicated videographer and photographer, Stanzin, and celebrated the second birthday of the trip – Gustave's – with tea and more cake. Stanzin's younger siblings even made Gustave a card. We thanked his family for such a special celebration and then headed on. The road along the way was slow; the area had experienced recent heavy rainfall, which we were again told was unusual compared to the historically dry summers, and several areas had been washed out by massive mudslides. Apart from a few totaled cars, there seemed to be little damage to property aside from the mangled road, and we did not hear of any casualties or injuries related to the weather. But it was clear that the critically important and already difficult-to-maintain mountain roads that connect Leh with the surrounding rural areas of the Zaskar region hang in a delicate balance, vulnerable to the changing and increasingly extreme weather.

Our return to the hotel in Leh where we started our journey seemed to come both quickly and very slowly. We enjoyed our last dinner with the GHE team, our guides Dorjay and Thinles, our driver Sonam Dorjey, and our excellent cook and guide Sonam Botey (Sonam C by nickname). Then we said our goodbyes. The next morning, we travelled from Leh to Delhi, where we had a last group dinner in the hotel restaurant and got a few hours of sleep before our early morning flight from Delhi to Dubai, then onwards back to Boston.

THE VIEW FROM HOME

Our trip was overwhelming, exhausting, and immensely rewarding and memorable. It was unlike anything any of us had done in our lives, and likely unlike anything we will ever do again. Our conversations during the trip and in the weeks following were stimulating, difficult, and heartfelt in a way that traditional academic scholarship is often lacking. The intimacy we developed among ourselves as a group, and the comradeship of having shared such a challenging experience together, is unique and special. Our group held together despite the adverse circumstances. Indeed, the physical and emotional challenges brought us together.

There are few words that can fully capture the expedition completely; it exists, much like the mountains that we journeyed through, on a scale that is difficult to grasp. Each of us is now connected to a place and to people a world away, in a way that could have never happened by simply studying a text or watching a film. We have a tactile, if only tertiary, understanding of what it means to live in an area beyond where the road ends. We know the smells and sounds of the village of Thangso, and we listened to the aspirations and concerns of the people who live there, who worry about what lies ahead for their village and their children, and who are dedicated to finding ways to create productive futures. We hope that the lights and micro-grids that we helped to install will provide as much for them in the years to come as the experiences they gave in return will provide for us.

COMMENTS FROM PARTICIPANTS

ERIK BAKER:

It turns out that historians -- even intellectual historians, even historians who write mostly about dead American philosophers -- can benefit, scholarly as well as personally, from the opportunities for travel and field learning that the Aramont Foundation trips provide. It turned out that the issues that I do spend most of my time thinking about -- the meaning of 'development' and 'progress,' the right way to think about 'communities' and how they change over time, the sources of social problems and solutions in a global world structured by capitalism -- were as alive in Ladakh as they are anywhere.

In fact, it was immeasurably rich to have a chance to regard those themes outside the archive or library, refracted through the lens of the experience of particular people in a particular place that neither I nor the Western scholars I write about had ever been forced to come to terms with. What I learned in Ladakh will most likely not appear explicitly in my dissertation, but it will be there no less, informing my analysis and reinforcing my conviction that the splendid isolation of many Western social scientists, snug and secure within the academic equivalent of the gated community, has permitted them to make preposterous claims (about 'community,' about historical change, about technical knowledge) that are nonetheless challenging to refute.



MIRIAM RICH:

This trip provided an opportunity for the sort of experience that is all too elusive in grad school: the chance not just to think or talk or write about something, but to do it. Now, as a trained PhD student, I am of course already overcome with the urge to offer anxious caveats about speech-acts, to nuance the unsophisticated opposition I just artlessly set up between communication and action. And yet, the crux of the point remains. This trip allowed us to engage with real-world issues in far more concretely physical and interpersonal ways than we are usually able to engage them. Within these new arenas of engagement, it allowed us to explore issues of major relevance to scholarship and pedagogy in the history of science: climate change, energy access, resource inequality, the lived uses and meanings of technology in social and cultural context. It deepened my intellectual and social relationships with department colleagues, including fellow grad students, a post-doc, and a senior professor. And the trip's physical, embodied challenges facilitated personal growth and interpersonal connection in ways that would be impossible to replicate with traditional classroom learning.

Part of the trip's significance, for me, was in challenging us to grapple with complicated issues of social power and positionality. These are highly relevant themes in my academic work, which deals with how biomedical discourses of gender, race, and disability have been invoked to naturalize social and political inequalities. This trip facilitated my thinking about social relations of power (particularly as they surround access to resources and technology) in unique ways.

In conclusion: it's no exaggeration to say that this is one of the most powerful, memorable experiences I've ever had as a graduate student. While I've read and will continue to read many works of scholarship touching on, for instance, the arrangement of social power; the cultural contexts of technology; and the social meanings of climate change, this trip gave me particular kinds of insights into these themes that no amount of reading could produce. And I've deepened my sense of intellectual (and human) fellowship with other trip participants through these incomparable shared experiences.



GUSTAVE LESTER:

Travelling alongside the GHE team and hearing their accounts of previous expeditions illuminated the creativity, local and political collaborations, nuanced care, and work needed to effectively install and maintain sustainable energy systems in Ladakh. Our conversations with locals throughout the Ladakh region and our own extensive travel by vehicle and by foot gave me an appreciation for the many difficulties posed by the built and natural environment for the movement of resources. It quickly became clear how the rough and elevated Himalayan mountains significantly intensified the labor behind most tasks. After I exerted some such effort myself, I felt better equipped to identify the legacy of labor in the built world around me – such as in the blended defunct, partly functional, and newly installed lighting and heating technologies found in the village of Thangso and in Rangdum Monastery.

Beyond labor, I learned how this specific layering of technologies represented a long and complex history of relationships between the local communities, the regional governments, and other organizations (such as GHE). Being there and able to ask questions allowed me to understand these historical and existing relationships from local perspectives, such as the different reasonings behind Thangso's long-term solicitation for electricity from GHE. This also included other community issues and aspirations that extended beyond lighting, most notably easier access to healthcare and other forms of educational opportunities by way of road construction. Finally, these exchanges provided me with a renewed sensitivity to the difficulties of translation, the nature of GHE's simultaneous (and perhaps unavoidable) role as provider and curator of our travel experiences, and encouraged greater reflection on my own ability to enact positive change in the pursuit of environmental justice or access to sustainable resources.

HANNAH CONWAY:

Having now had two opportunities to join trips offered by the History of Science department through the funding provided by the Aramont Foundation, I can safely say that these outside of the classroom courses have been the absolute highlights of my graduate education. On an interpersonal level, the ability to connect with colleagues and faculty while travelling in unprecedented and unique – I have secured strong friendships and invaluable mentor relationships through getting to know my colleagues through travel. My scholarship has been deeply influenced by these trips as well- the first (to the US Southwest) opening up a whole new connection between my study of infrastructure and art and the second (to Ladakh) reaffirming my commitment to studying history with the purposes of fighting for policy changes that ensure environmental justice and equitable infrastructure access for underserved and protected communities back home in the US. Each journey has seen myself and my work come back changed.

Being so far from home in a truly incredible part of a world definitely felt like a once in a life time trip, but it left me thinking about why people travel so far to do this kind of service work when infrastructural inequities exist in their own backyards. I'm thankful for my time spent with GHE and seeing their model in action, and I'm interested in trying to bring some of their principles into my own work – particularly an emphasis on community engagement with the technologies that are meant to fulfill a specific need as well as a focus on empowering people to hopefully find long term fixes to structural inequities rather than a temporary solution to large-scale problems. This trip also raised a lot of questions for me about

how we frame sustainability and the ways we sell “sustainable futures” to a variety of publics. Who defines “sustainable?” What are we trying to sustain? For whom? All of these important questions felt very real and tangible while working in the field with GHE and the people of Thangso, and I am incredibly grateful for the opportunity.

JACOB MOSES:

The 2018 Department of the History of Science’s History Beyond the Classroom trip to Ladakh, India was an exciting and enriching experience that generated unexpected insights. At the outset, I was excited at the prospect of traveling to northern India, trekking in the Himalayas, and assisting with installing solar panels in the village of Thangso – and, indeed, all of these elements proved to be challenging and immensely rewarding at a personal level. However, the expedition proved to be much more than the initial itinerary let on. From beginning to end, the entirety of the trip pushed me in important ways to more critically consider the relationship between technology, development, and health; the politics of tourism; and life in remote regions that today often fall under the gaze of global development and global health. I anticipate applying these insights in my future scholarship, teaching, and travel.

A striking lesson brought home from the trip was that what is ‘global’ needs to be vigilantly rethought in light of local experiences. The organizer of our trip, Global Himalayan Expedition (GHE), gives priority to the ‘global’ in its name and mission of bringing tourists to remote villages. For GHE, global seemed to be about interconnectedness and facilitating flows of technology and tourism. They undertook their work with an eye to large-scale phenomena that transcend regional borders, such as climate change and urbanization, which threaten the resiliency of small villages. But the challenges villages like Thangso face cannot simply be conflated with smallness and remoteness. Tourists fly into the Himalayas drawn by the romantic allure of villages, misleadingly portrayed as ‘lost in time.’ Global development projects traffic in the images of technology-as-salvation. Yet the story on the ground was far more complicated – far more interesting – than either of these portrayals suggested.

Naomi Oreskes, 2018



TRIP 4: MEXICO AND PANAMA, JANUARY 2-12 2019

Prof. Gabriela Soto-Laveaga

Research Assistant: Angélica Marquez-Osuna

PREFACE: RATIONALE FOR A SEMINAR ON HISTORIES OF WATER TECHNOLOGIES

As historian Michel-Rolph Trouillot reminds us in his seminal work, *Silencing the Past: Power and the Production of History*, where we begin our history is as important as *when* we begin it. In other words, place matters when we speak about histories of science, and so does time. For that reason, over the course of ten days, we visited sites of hydraulic engineering in Latin America that spanned more than two thousand years. Our goal was to understand the various meanings and manifestations of water engineering in times of empire (both Native American and European), conquest, nation-building, neo-liberal reforms, and climate change. The Aramont Foundation's History Beyond the Classroom fund supported nine History of Science Graduate students, including teaching fellow Angélica Marquez-Osuna, Max Ehrenfreund, Jordan Howell, Christian Jongsik, Colleen Lanier, Kat Poje, Tasha Schoenstein, Gili Vidan, and Gaby Baez, on this trip.

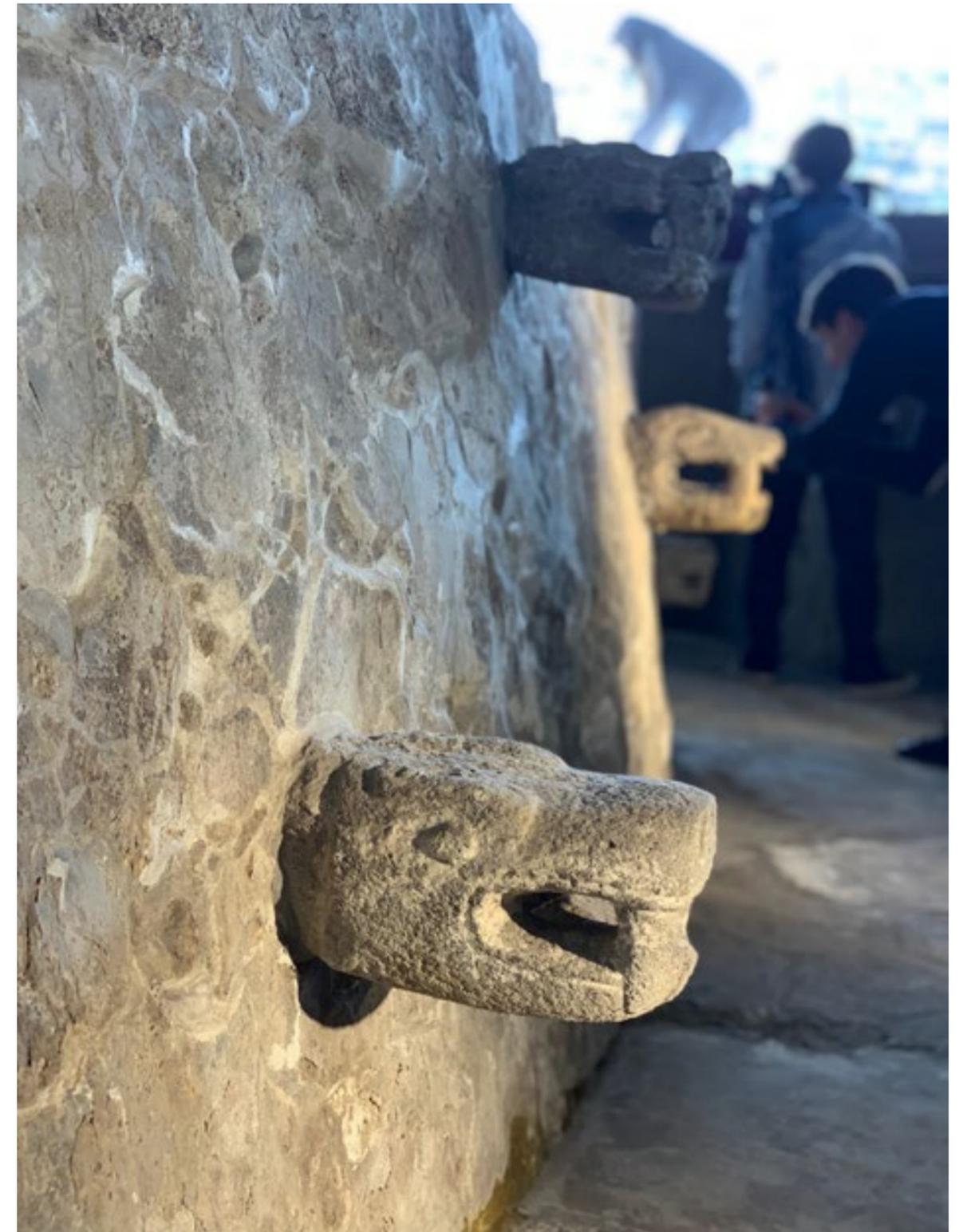
I wanted students to first experience the awe-inspiring structures and engineering of a pre-Hispanic world before encountering the breathtaking Panama Canal. From a pedagogical point of view, the trip could not start at the Panama Canal. The students, I felt, would have a distorted sense that hydraulic technology was imported to the region. By beginning our trip in the archeological sites of Mesoamerican empires who altered the course of rivers, who built a city on a lake, and who farmed on so-called floating gardens, then students would have a more nuanced and layered understanding of the importance of water in this region.

How students learned – the order in which they “saw” Latin America – mattered. In Panama, for example, the last site we visited was the canal. If we had seen the canal first we would have been awestruck – indeed, it might have overwhelmed everything else. For that reason, we first learned about how the land and water have been altered by the construction and continued presence of the canal through the eyes of a Smithsonian hydrologist. As we learned, the rivers of Panama now exist to feed the canal. We then went to the tiny yet powerful Afro-Antillean Museum to learn about the role of race in the building of the canal. Finally, as our last stop in Panama, we visited the Canal and its museum. Here, the students looked for the missing stories of labor, race, and nature when talking about technology. How one constructs the narrative matters.

Finally, I applied for additional funds to include two Mexican students from UNAM. My criteria for selection were simple: they had to be both excellent students and low-income. The two selected students, Lorena Rodas Pineda and Lucia Granados Riveros, enriched our trip in ways that are difficult to quantify. They helped to bring our theoretical discussions to a different level, for they forced us to think bilingually and bi-culturally while keeping us grounded on the social issues and daily impact of technology projects. As one grad student explained, because of the UNAM students, we did not feel like tourists; rather, we were immersed, fully, in Latin America.

What follows is the report put together by all who participated.

– Gabriela Soto Laveaga



Coleen Lanier, 2019

INTRODUCTION

Hydrologists and hydraulic engineers must be historians as well. In the Valley of Mexico, the problems that the flow of water has posed for humans have persisted for millennia, and the watershed has been continuously engineered on a massive scale. This process began, at the latest, about 2,000 years ago, when the inhabitants of what is now Teotihuacan diverted a river for drinking water and sewage.

The landscape of the Valley of Mexico today is essentially a material database on human-water interactions through a millennium. There has long been either too much water or not enough. Both flooding in the city and drinking water shortages are commonplace here. Perhaps, however, it is not a history of too much or too little water – but one of too much urban construction and too many people. The changing relationships between humans and water are evident in the way that environment and infrastructure blend into one another: lakes and lands themselves become technologies for human life, and human life is interrupted by the unruly technologies it depends on. This is the case not only in the Valley of Mexico, but also in the City of Panama. Hydrologists of the Panama Canal rely on historical records to predict changes in the long-term flow of water, to respond to increasing water usage throughout the country, and to prepare for severe weather in the future. These records take the shape of forests and dams, as well as oral histories, institutional memories, and data logs.

With histories like these in mind, nine doctoral students from Harvard University’s Department of the History of Science and two students from the National Autonomous University of Mexico (UNAM) joined Professor Gabriela Soto Laveaga to study the relationships between societies and watersheds at several sites in Mexico and Panama in January 2019. This field seminar – generously funded by the Aramont Foundation, a Santander Research Fund for Innovation and Education Systems grant, and the David Rockefeller Center for Latin American Studies at Harvard – examined how knowledge of the history of hydraulic engineering in Latin America can inform contemporary responses to long-standing challenges in the distribution and control of water.

For historians of science, studying how scientists and engineers have applied their expertise in the past can reveal what practices in research and in technology are most likely to succeed today. For instance, even a well-engineered project might fail if it conflicts with the way ordinary people interact with the landscape. Hydrology is not just about water; it is about humans, too. Hydraulic engineering is also about power, and about cultural and national identities. In this respect, what made the trip most significant for us might have been the exchange between Harvard and UNAM students. This exchange not only provided young scholars with complementary interests and training to share their knowledge – it was also a chance for us to discover and articulate how meaningful the history of water was for each of us personally, including our understanding of where we come from and who we are.

JANUARY 2, 2019 – ARRIVAL IN MEXICO CITY

Upon our arrival in Mexico City, we had dinner with water policy expert Felipe de Alba, who talked about two different water paradigms in Mexico’s history. He argued that pre-Hispanic societies lived with water, appreciating the interconnectedness of water and land. Spanish colonists sought to separate land and water, leading to centuries of efforts to drain the lakes. With all of the changes in Mexican history over the last century – the Porfiriato, the Mexican Revolution, neoliberal reforms – this water paradigm has remained unchanged. Alba described water policy in Mexico City as an “impossible problem.” Work is being reinvigorated by new government technocrats, who have brought new ideologies and ideas to the table. But, Alba said, efforts are frustrated by different paces of change. The young technocrats, existing engineers, and bureaucrats are all committed to the same goal of solving the city’s water problem, but they are moving at different tempos.

JANUARY 3, 2019 – THE TEMPLO MAYOR AND THE CHINAMPAS OF XOCHIMILCO

Navigating the Future with Waterscapes of the Past

On our second day, archeologist Raúl Barrera Rodríguez, director of the National Institute of Anthropology and History’s Urban Archaeology Program, invited us to see something extraordinary: a part of an active archeological site not yet open to the public. There, we saw the remains of one of two towers of skulls that Barrera’s group discovered. Spanish conquistadors described the *tzompantli*, or racks of skulls, as holding over 130,000 craniums. Barrera’s discoveries suggest that figure might be accurate.

Archeologists believe that, for the Aztec people, it was an honor to be sacrificed. Their findings also suggest that, contrary to the depictions of the Spanish, the ritual sacrifices were about life just as much as they were about death. Only the finest people were sacrificed – “perfect specimens” – mostly male warriors, but also women who died in childbirth (they were considered warriors too, as they had battled life and death). A small number of the skulls have been found to be children’s, and archeologists believe that these youth were seen as representatives of the god of death.

Barrera also took us to his laboratory, where DNA analysis reveals the place of origin of the skulls, and to the Museo del Templo Mayor. Templo Mayor is the city’s sacred center, and like the rest of the city, it was built layer-upon-layer. At Templo Mayor, we walked on a road built in the 16th century, and below that, one from the 14th century. Below the petrified trunk of the sacred tree at Templo Mayor runs a trickle of water – the only remains of the original lake.



Next, we visited Cárcamo de Dolores, a pumping station for the city's municipal water system, located in Chapultepec Park. The station serves as a material and symbolic entry point for water into the city. The water originates from the Lerma River and is transported via a system constructed between 1942 and 1951, which brings the water 60 kilometers to the east. The pumping station features a fountain, which represents the Aztec rain god Tlaloc, built by the Mexican muralist Diego Rivera and the architect Ricardo Rivas. Inside the station is a mural, also by Diego Rivera, called *Agua, el Origen de la Vida (Water, Origin of Life)*. The mural itself was originally underwater. Rivera crafted the fountain and mural between 1950 and 1952. The mural depicts all of life, from single-cell organisms to the most complex – humans. As historians of science, we were especially interested in Rivera's extensive polemical use of diagrams and images from scientific texts. The site's design offers a modernist promise of infrastructure-provided clean and abundant water – a stark contrast to the failing hydraulic-political systems we saw in Mexico City.

Later in the afternoon, we visited Xochimilco to learn about farming on *chinampas*. Chinampas are a pre-Hispanic mode of lakebed agriculture, dependent on the formation of artificial islands from reeds, tree branches, and mud. The Aztecs developed and implemented the method on a large-scale, and a dense network of chinampas and canals surrounded ancient Tenochtitlan.

Chinampas can provide self-sufficient and sustainable agriculture in the present, but the system is threatened by urbanization, pollution, and abandonment.

We received a tour of some chinampas in active use for farming from Lucio Usobiaga, a founder of Yolcan, which is a nonprofit organization dedicated to reviving and maintaining these ancient techniques. They hope to show that chinampas are still viable and that they can be profitable – more so than selling the land. Chinampas can also provide sanctuaries for the Mexican axolotl, which is vital to Mexico City's ecosystem. It is also one of the most widely used laboratory animals in the world, and Lake Xochimilco is the axolotl's only remaining natural habitat. Scientists and farmers, including Yolcan, are working to re-establish an ecosystem that is favorable to the axolotl.

JANUARY 4, 2019 – TEXCOCO

Conflicting Visions of Water, Land, and Air

On assuming the presidency of Mexico in December 2018, Andrés Manuel López Obrador ordered the cancellation of the construction of Mexico City's new airport, which was being built in the drained lakebed northeast of the city. A week later, our group toured this eerie site – unthinkably vast and now almost desolate of any human activity. Parabolic towers of naked steel arched into the hazy sky, strange monuments to a dream of Mexican economic and technological progress that has been interrupted by violence, bitterness, and a now national political movement.

Many Mexicans believe that restoring Lake Texcoco, as well as part of the ecosystem that existed in the pre-Hispanic era, is the only way to ensure a sustainable supply of drinking water while controlling flooding in Mexico City. They worry that the airport will permanently foreclose that possibility, while serving only the minority of Mexicans who can afford to fly. In a 2006 incident associated with the



Tasha Schoenstein, 2019



conflict over the airport, police officers were accused of killing several citizens and perpetrating some two dozen sexual assaults at Atenco, a suburb of Mexico City near the site of the airport.

We met with scientists and policy experts who have sought to design an environmentally sound airport. We talked about efforts to capture shorebirds and other fauna before construction and transport them safely to other watersheds. We reviewed the complex plan for draining and compressing the soil to prevent the continuing subsidence of the artificially desiccated lakebed from warping the planned runways. We drove to Lake Nabor Carrillo, designed by hydrologists half a century ago as a partial restoration of the ancient Texcoco.

Many of those we spoke with were confronting the concern of unemployment in a sluggish national economy, exacerbated by López Obrador's plan to drastically retrench government science. They were frustrated with the public outrage over the airport, which they felt had wrongly politicized an issue that should have been left to the experts. Former President Enrique Peña Nieto conducted the initial planning and surveys for the current project conducted in secret – an approach that our interlocutors had originally hoped would prevent a potentially uncontrollable public debate over the airport.

For us, the experience was a sobering reminder that the questions we ask about science historically remain relevant today. How does the meaning of scientific evidence depend on status; on membership in an elite bureaucracy, say, or in a disadvantaged social class?

Who can claim scientific authority to talk about issues of political concern, and on what basis? How do scientists and the public establish and maintain trust?

The conflicts over water that have defined life in the Valley of Mexico for centuries continue up to this moment. Oppositions to plans to drain water for public works proved problematic for Spanish colonists at the beginning of the 17th century, just as they have for the Mexican state at the beginning of the 21st. While activists and environmentalists appeal to a pre-Colombian paradigm of connectedness between water and land, the state's experts invoke the Aztec heritage of landscape-scale hydrological infrastructure. Both turn to the past for legitimacy in the present, and for control over the future.

JANUARY 5, 2019 – TEOTIHUACAN

The Place of Water in the City of the Gods

On our third day, we traveled to Teotihuacan, an archaeological site with a Nahuatl name meaning the Place Where Men Become Gods, or the Place Where Gods are Born. Its landscape is dominated by twin temples devoted to the sun and the moon, and the Avenue of the Dead which runs between them. Over the course of the next 10 hours, we heard from two different archeologists, Dr. David Carballo and Dr. Nelly Nuñez Rendón, and had lunch in an underground grotto restaurant which has been open since 1900.

Archaeologists know relatively little about the true “Teotihuacanos” who built and inhabited the city between 100 BCE and 500 CE, around 1000 years before the formation of the Aztec Empire. Still, as we walked past the ruins of ball courts and palaces, Dr. Carballo made clear that the Teotihuacanos ought to be considered cosmopolitan. The extant hieroglyphics come from a variety of known languages. Archaeologists have found offertory remains including objects that originated as far away as modern-



Coleen Lanier, 2019

day Guatemala, and would have been traded for Teotihuacan's prized obsidian tools and weapons. Mural styles on buildings indicate that specific compounds were set aside for traveling merchants, so that they would have places to live while they plied their wares in the city. In addition to commerce, Teotihuacan had significant agricultural production, supported by elaborate irrigation systems.

A history of water engineering is evident not only in the aqueducts built to service the city's fields and homes, but in the ritual nature of Teotihuacan's urban planning. The Teotihuacanos diverted the San Juan River from its original course across the valley, and directed it into a canal so that it would run perpendicular to the Avenue of the Dead. They accomplished this with obsidian tools, without animal labor, and without an enslaved population. Some of the canals were intentionally blocked off to flood the plaza in front of the Temple of the Feathered Serpent, likely to materialize a cosmological vision of a sacred mountain (the temple) rising from a primordial ocean (the flooded plaza). Entering the Temple of the Feathered serpent, we saw colorful murals of birds with obsidian eyes – eyes that had been seeing for thousands of years.

In the afternoon, we had the incredible opportunity to enter La Ventilla, an archaeological site still under excavation and closed to the public. Its chief archaeologist, Nelly Nuñez Rendón, guided us through the site. La Ventilla, named after the ranch whose lands it had been buried under around 650 CE, was a large agricultural neighborhood on the outskirts of Teotihuacan. Surrounded by a wall and a dual-functioning canal and road, it offered us the clearest sense of the way water was made to flow into everyday life for the Teotihuacanos.

Walking on the floors of buildings from the first half of the first millennium CE, we saw the ways in which multi-leveled foundations were built below and above the aqueducts, so that a second floor might become a basement as time passed, but access to sewage removal and freshwater remained. The sewage became fertilizer for the neighborhood's fields, and wells supplemented aqueducts in dry seasons. Although the neighborhood was part of Teotihuacan, it had the necessary agricultural and hydraulic infrastructure to be self-sufficient.

Dr. Nuñez Rendón taught us that these technological artifacts offer clues as to the political life of the Teotihuacanos. They evidence an uneasy alliance between a miniature city and a dominating metropole. La Ventilla offered a first line of defense for Teotihuacan, should outsiders invade; and Teotihuacan offered goods and markets for La Ventilla's inhabitants. But La Ventilla asserted its autonomy through its independent food and water systems, and through its outer wall, which was closed off to the major city.

Dr. Nuñez Rendón demonstrated how changes in the infrastructure suggest changes in political arrangements. For instance, around 50 AD, the neighborhood switched the orientation of its temple to match the temples in Teotihuacan, and changed their mural styles to match those of Teotihuacan, suggesting the emergence of an authority enforcing building codes, and a greater central oversight of La Ventilla. From both Dr. Carballo and Dr. Nuñez Rendón, we saw that water infrastructure can be an ancient materialization of political landscape, and that the archaeological remains of these infrastructures are resources for the writing of history.

JANUARY 7, 2019 – AGUA SALUD

Thinking Water through Trees in the Panama Canal Watershed

Two scientists from the Smithsonian Tropical Research Institute (STRI), Robert Stallard and Adriana Tapia, and an American postdoc project assistant named Casey, guided us through the field sites of Agua Salud. STRI supports long-term data collection on the Panama Canal Watershed's sediment, water supply and quality, and infrastructural capacity. Dr. Stallard explained that the multinational investment in the maintenance of the Panama Canal has turned the watershed into one of the most thoroughly studied in the world. Formed in 2008, Agua Salud's approach to water, however, is through land and, more specifically, forests. Through a unique land-leasing agreement with local benefactors, and with funding from primarily private donors, Agua Salud studies 700-hectares of land. By tracking water flow and biodiversity across old-growth forests, forests planted for commercial harvesting, grasslands, and even cattle fields, researchers aim to establish best practices for water conservation in the watershed, and to make hydraulic data available to those with commercial interests in maintaining the water flow of the region. Agua Salud professionals work with local Panamanians on issues ranging from forest fire prevention to the establishment of land histories, and from plant diversity surveying to ranching.

We viewed three different types of land cover in one day, marveling at the stark differences between the layered growth and thick underbrush of the old-growth forest, and the open expanses of the grassland. While in the forest, we explored the weir system that allows Agua Salud scientists to collect data on changes in the land's water supply. We learned that constant human, artificial interventions are necessary to keep the reforested forest alive. The main challenge to Agua Salud reforestation efforts is a variety of sugarcane called "canal grass." Canal grass is invasive and overwhelming, and it

is killing other vegetation. Constant weeding is necessary to allow other plants to grow. In this sense, the reforested forest, despite its “natural” appearance, is similar to a technological infrastructure which needs maintenance. This fact blurs the conventional boundary between built and unbuilt environments. The day gave us new insight into the interdependence of human actors, forest fauna and flora, and water in the creation of the environment.

JANUARY 8, 2019 – CATHALAC, THE AFRO-ANTILLEAN MUSEUM, PANAMA CANAL MUSEUM, AND THE MIRAFLORES VISITOR

Water Narratives in Panama City

In the morning, we walked through the “Ciudad del Saber,” the former American zone and military base of the Panama Canal, to reach the office of CATHALAC, the Centro del Agua del Trópico Húmedo para América Latina y el Caribe. CATHALAC is an NGO focused on integrated watershed management and climate change preparedness in the Dominican Republic, Mexico, and Panama. CATHALAC staff Octavio Smith Molinar and Katherine Bernal guided us through the organization’s work. CATHALAC was an object lesson in the NGO science. Words such as “vulnerability” and “women’s empowerment” were used to justify CATHALAC’s deliverables, but questioning about the metrics behind these values revealed little engagement with issues like class and race in equitable water access organizing.

We then took a bus to the Afro-Antillean Museum of the Panama Canal to meet with curator Melva Lowe de Goodin, an Afro-Panamanian academic and writer. It is hard to overstate the privilege of being present in the Afro-Antillean Museum with Lowe de Goodin as our guide. Lowe de Goodin was born in Red Tank, a town in the Panama Canal Zone. As she proudly told us, her grandparents were of West Indian descent. They had moved from Jamaica to Panama to help build the canal. Although much of the Afro-Antillean Museum depicts the building of the Panama Railway (1850-55) and the “two” canals (French and later American), Lowe de Goodin insisted that the Afro-Caribbean history of Panama extends back beyond this story of labor. She argued that the commencement of the transatlantic slave trade in the early 16th century is where African history of Panama begins. In other words, one cannot understand the history of the Panama Canal without understanding the history of slavery that shaped the Atlantic world.

Lowe de Goodin guided us through the cultural, social, and political history of Afro-Caribbean peoples in Panama, using the many objects of the museum to anchor our conversation. She drew our attention, for instance, to a large and prominent railcar. These were the carts that West Indian workers filled, she explained – this was what it took to build the canal. And yet, Lowe de Goodin was quick to remind us that not all people of African descent in Panama were laborers in construction. Many women, for instance, were teachers, worked as domestics, owned and operated hotels, or were engaged in sex work. On the American canal, workers were paid differently according to their background; Americans were on the “gold” roll, and were paid in USD; but black workers, Spanish-speaking Panamanians, and others were on the “silver” roll, and got paid in Colombian pesos. The differences in “gold” and “silver” roll extended beyond pay into all aspects of life in Panama at the time.

We then visited two other museums, the Canal Museum in Casco Viejo and the Miraflores Visitor Center located adjacent to the Miraflores locks of the canal. In a single day, we experienced very different forms of public history firsthand. Each museum commemorated a particular aspect of the Canal – the labor





and immigration required to build it (Afro-Antillean Museum); the tremendous and awe-inspiring feat of French and U.S. engineering that is the continent-spanning canal (Miraflores Visitor Center); and the way the canal has functioned to celebrate colonial and more recently postcolonial state power (Canal Museum). We saw firsthand that, as the late Haitian historian and anthropologist Michel-Rolph Trouillot argued, any historical narrative is a “bundle of silences.” By visiting all three museums in one day, we were able to untangle the narratives and their silences, while also engaging with the question of the different ways technology is commemorated and remembered in public spaces.

JANUARY 8, 2019 – CIUDAD OBREGON

Water and Wheat in the Breadbasket of the World

Arguably the birthplace of the Green Revolution, the Yaqui River Valley is still an active site of climate change in what has always been a desert environment. Most varieties of wheat grown around the world were bred here, in Sonora. For agricultural production in the valley, newly engineered strains of wheat are no less important than the various organizational structures that facilitate both water management among local producers and close collaboration between scientists and growers. Accordingly, we spent most of our day discussing the work of management and governance. The importance of organizational design, political participation, and managerial expertise for operating technological infrastructure or any large-scale scientific enterprise was the theme for the day. Professor Soto Laveaga, in her research on the relationship between different professionals at the Ciudad Obregon field sites, drew our attention to the importance of the entanglements of land, people, plants, and water for the development of scientific expertise.

At the headquarters of the Distrito de Riego del Río Yaqui (Yaqui River Valley Irrigation District), we met with General Director Humberto Borbon, who answered our many questions about water management in the area. We then met with Rodrigo Tovar Canales, the director of the district’s Technology Department, in the control center. We saw the monitors for all the district’s wells and discussed how effective water management requires a major investment in control infrastructure. From headquarters, the group went to see one of the district’s wells, and met with the well’s manager, Pedro Hernandez. Having just witnessed such a well via the monitors in the control center, it was interesting to see the newly mechanized apparatus in action, which allows remote, precision control of the system’s sluice gates.

We then continued to CENEB (Norman E. Borlaug Experimental Station), a partnership between scientists and agricultural interests in the region. We met with local producers along with Karim Ammar, a wheat scientist at CIMMYT (International Maize and Wheat Improvement Center), and Marco Antonio Carreón Zuñiga, the federal government’s regional director of agriculture. Later, the group went together to watch researchers at work in an experimental wheat field. A key question we returned to throughout the day was how such partnerships between scientists and producers are maintained, and whether this one, like the seeds it produces, could be exported around the world.

JANUARY 11, 2019 – UNAM RESEARCH EXCHANGE

Building International Networks of Scholars

Throughout the trip, students ranging from doctoral candidates to first-years built relationships across their institutions. The Harvard students deeply appreciated the insight UNAM students Lucia and Lorena shared as we drove through Mexico City on our way to field sites. They explained the history that led to the government stoppage of oil supplies, leading to the multi-block-long lines of cars waiting to refuel that we saw at every gas station. And they discussed the controversies surrounding the construction of the Mexicable sky trams that passed over us on the road near Ecatepec. Because of Lucia and Lorena, things that would have been part of the scenery became part of our research into the built environment and technological expertise.

Our last day in Mexico City, which was dedicated to graduate student project presentations at UNAM and a dinner for UNAM and Harvard scholars alike, was especially valuable. It was an intensified experience of the kind of exchange that had made the presence of Lucia and Lorena so welcome on the trip. We shared our research on trust in digital financial technologies (from Gili Vidan) and the impact of socialism on Chinese state agricultural planning (from Jongsik Christian Yi). We heard research about the transformation of the chicken into a model organism (from Manuel) and the international development of pollution measurement standards (from Natalia Verónica Coloballes). We asked questions of our UNAM doctoral colleagues, and received feedback from UNAM professors in the Philosophy of Science, STS, History of Science, and the History of Medicine. The faculty who generously commented on our research included Dr. Ana Barahona, Dr. Vivette García Diester, Dr. Edna Suarez, and Dr. Gisela Mateos.

The conversations skipped across Spanish and English, with more than a few text references in common. Through the presentations and the meal that followed, we forged connections that crossed intellectual and physical borders, bound by a shared passion for the writing of history. This was perhaps the greatest gift of the History Beyond the Classroom trip.

Christian Jongsik



COMMENTS FROM PARTICIPANTS

GILI VIDAN:

This trip was my first visit to Latin America, and while it allowed me to experience a richness of cultures and histories I had not yet had a chance to study closely, a key personal takeaway from this trip is actually the ways in which it allowed me to reflect back on the context of my own upbringing in Israel and the intertwined histories of science, technology, nationalism, and colonialism in that context. As a scholar, I rarely have the occasion to think about my subject matter in such lived terms and to relate it to my own experiences, but witnessing the layering of colonial legacies, nation-making narratives, and present-day consequences of science and technology projects in Panama, Mexico City, and Ciudad Obregón, allowed me to take a moment and make connections with the brief history of water management and technological solutionism in Israel and Palestine that I've experienced as a resident rather than as a researcher. It is a powerful perspective which I hope to find ways to incorporate into future teaching myself for my students.

I feel like the presence of two UNAM students in the group for the entirety of the trip was such a key aspect of it that I can't now imagine it otherwise. The final day's presentations and exchange at UNAM was also a really meaningful experience for me. I was challenged to think of the relevance of my project to an audience that I know is, geographically at least, not inherently interested in my focus on the US, thus making me do the work that many of my colleagues have to do in thinking more deeply about the relevance of their work, but which I'm often spared. To the extent that the trip's historiographical argument was that the histories of science and technology can be told from a perspective that centers Latin America, the exchange program was similarly a reminder that scholarship in the history of science and technology too exists in parallel to my own small US network and I ought to make a greater effort to connect to it. This opportunity was a great first step.

JONGSIK CHRISTIAN YI:

Through my coursework with Professor Soto Laveaga, I learned that current problems in relation to EuroAmerican-centrism, colonialism, capitalism, and racism and so on have roots in the history of Latin America since the 16th century. Adding detailed, local contexts to such understanding, this trip convinced me that these problems are globally structured and overlapped with other parts of the world. Based on my experience during this trip, I could decide to research the comparative and connected histories, encompassing Latin America, Southeast Asia, and East Asia.

The workshop at UNAM reminded me of the importance of the mutual recognition between Anglophone and non-Anglophone scholars. Sometimes it is easy for English-speaking scholars to be unaware of non-English scholarship. We should be diligent and learn from non-Anglophone scholars and rightly acknowledge their contributions to the global academy.

COLLEEN LANIER CHRISTENSEN:

Learning about pre-Hispanic, colonial, and modern water management practices in Mexico and Panama helped to disrupt my assumptions about when, where, and how science takes place. It's one thing to learn about these topics from reading scholarly writing; it's quite another to study water infrastructure across centuries in the field from archeologists, scientists, farmers, and engineers. The experience will not only inform my own research, but it will also enable me to be a more critically reader of others' work.

On a practical level, the exchange with UNAM has facilitated connections with new networks of scholars. I met several graduate students and postdocs whose interests intersect with my own, and I have already been in touch with them to further discuss our work and exchange materials.

JORDAN HOWELL:

Latin America, as we learned, is not simply a place of colonial experimentation. We learned that the sophisticated political ecology of water that sustained precolonial Tenochtitlan is not only a vestige of the past but a way of engaging with nature and technology that might teach us something about the future of Mexico City.

KAT POJE:

This experience has taught me that documents alone are not enough. Whenever possible, as I write histories of technology, I will interview living experts, so that I write in light of the knowledge and affect of the people who bring that technology to fruition.

TASHA SCHOENSTEIN:

For many of the scientific or engineering projects we visited, including Agua Salud, the Texcoco airport, and CIMMYT in Ciudad Obregon, a very specific sense of place was important to what the project had been and had become. The trip made me realize that I want place to matter in my next project in a stronger way than it does in my current project. The trip also made me want to learn Spanish and to think more about how Latin America interacts with and relates to the US and Canada. For instance, it made me want to return to the first research project I did in graduate school, about the history of land making in Boston, and put that story in conversation with the other large land-water engineering projects we examined on this trip, especially the contemporaneous building of the Panama Canal.

MAX EHRENFREUND:

I study the history of the social sciences, which most people think started in France and England in the 18th century. What I saw on this trip definitely makes me question that idea.

LUCÍA GRANADOS RIVEROS, UNAM:

Nuestro grupo bicultural, me permitió aproximarme a la región con otra mirada, pienso que con frecuencia estamos tan interesados en los acontecimientos internos que olvidamos incluir el contexto global, escuchar las opiniones del grupo desde una perspectiva externa definitivamente abrió mi panorama. Me integré en una dinámica grupal sumamente amistosa y proactiva que buscaré reproducir en mi entorno académico. Atesoro los lazos de amistad que iniciamos, las conversaciones, recomendaciones de películas y literatura me permitirán seguir aprendiendo de este viaje durante mucho tiempo.

LORENA RODAS, UNAM:

Durante diez días de viaje por México y por Panamá tuve la fortuna de poner en práctica mis conocimientos profesionales y compartirlos con mis colegas de la Universidad de Harvard. Me enriquecí con el diálogo académico que tuvimos aprovechando al máximo el tiempo compartido. También aprendimos de la gente que conocimos en el viaje: científicos, agricultores, historiadores, ciudadanos tanto mexicanos como panameños.

Disfrutamos juntos de la comida, los sabores, las caminatas, los hermosos paisajes, las risas, y el amor por nuestra profesión. En este viaje valoré la importancia de compartir el conocimiento forma interdisciplinaria e interdialogica, ya que esta experiencia ha cambiado mi vida y pienso que también de todos los compartimos este viaje afortunado.



PART 2: BEYOND THE CLASSROOM, IN THE PANDEMIC

In March 2020, faced with the global pandemic, Harvard had to shutter the university. Responding to the utterly unexpected move online – field trips were manifestly impossible – we reset the aims of the Beyond the Classroom projects. Three enormously successful ventures began then, with more in the works. One involved pivoting a long-planned exhibit (joint with the Harvard Museums of Science and Culture) on Freud and visualization; a second answered to a huge graduate student need to help them acquire and analyze archival sources in the midst of the pandemic; yet a third, surprisingly, forged a way to bring physical artifacts from the history of technology directly to the students; and, fourth and finally, we redesigned the methods course to bring (via Zoom) eight remarkable, younger scholars to talk about their career trajectories and to speak about their books. We distributed physical copies of those eight volumes to each member of the seminar.

Leah Aronowsky, 2016



PROJECT 1: ONLINE EXHIBITION

Online Exhibition in the Collection of Historical Scientific Instruments, Department of History of Science: The Interpretation of Drawings: Freud & the Visual Origins of Psychoanalysis

The following is excerpted from a digital exhibit at the Collection of Historical Scientific Instruments, Harvard University. Visit https://chsi.harvard.edu/current_exhibitions/freud-interp-drawings to see the full exhibit.

This exhibit was originally intended to be seen in the museum, but was instead mounted in an online, interactive format due to the ongoing pandemic. It was curated by Nimrod Reitman, a postdoc in the Department of History of Science 2019-2021, in close collaboration with Peter Galison and Elizabeth Lunbeck. The exhibit was produced by the Department of the History of Science, the Collection of Historical Scientific Instruments, and the Harvard Museums of Science and Culture. The online format allowed the curators to offer a degree of interactivity to viewers – among them, several students specializing in the history of human sciences and, in particular, the psychological sciences.

This exhibition invites the viewer to explore the role Sigmund Freud's sketches and drawings played in the development of his psychoanalytic theories. Freud's early drawings, produced when he was a medical student and shortly thereafter, are straightforwardly anatomical and based on careful observation. As he turned to observing and describing the inner workings of the mind, which were, by definition, not subject to direct observation, Freud faced a more difficult challenge: How could unseen processes be represented?

By examining Freud's unpublished and published writings and correspondence, and diving into the materials that inspired him, we encounter pivotal moments in his career and trace the evolution of his ideas as he wrestles with the problem of representation across his lifetime. This intimate and rare encounter with Freud's artwork and drawings offers new insights into the man and mind behind some of the most influential and controversial therapeutic techniques ever developed.

Portrait: Sigmund Freud, by Max Halberstadt c. 1921

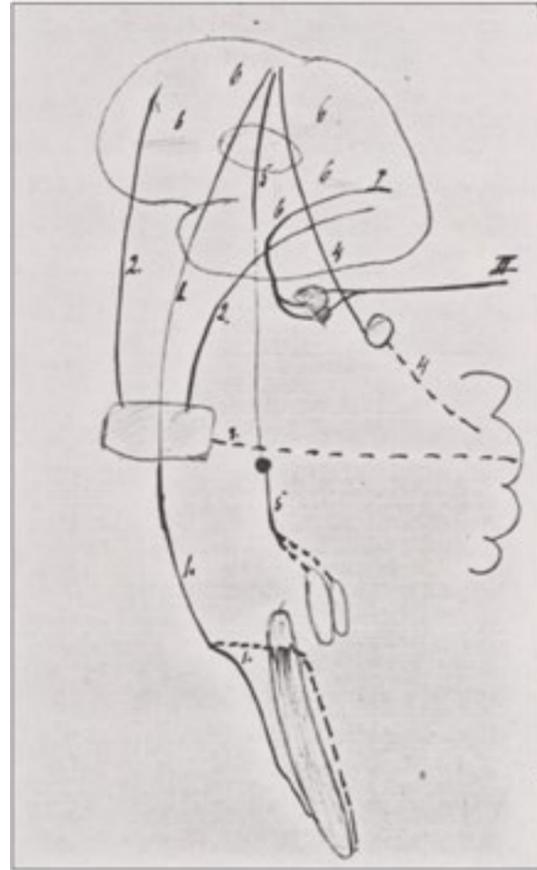
Drawing: The Petromyzon and the Riddle of the Eel (1876), © Freud Museum, London

FREUD, THE SCIENTIST

Freud contributed to the most current debates of his time in the evolving field of neurology. His most significant pre-psychoanalytic work concerned aphasia (a brain impediment affecting the ability to use, produce, or comprehend language) and infantile cerebral palsy. Freud attributed the development of cerebral palsy to pre-natal conditions – contrary to prevailing medical opinion, which held that it was caused by asphyxiation during birth. He also went against prevailing opinion in suggesting that aphasia did not necessarily result from single or multiple brain lesions, but rather from degeneration of the transmission mechanism between functional zones in the brain. Many years later, medical imaging techniques would validate his groundbreaking insights, which were marginalized in his own time.

INTRODUCTION TO NEUROPATHOLOGY, KRITISCHE EINLEITUNG IN DIE NERVENPATHALOGIE (1885-1887)

This drawing, which is part of an unpublished manuscript on neuroanatomy and neuropathology, depicts different functional connections between the cortex and other parts of the human brain. Unlike many of his contemporaries, Freud opted for a nuanced model, according to which functions (motor, sensory, perceptive, etc.) were encoded in the brain through a system of representation. Aware of the difficulty in representing cognitive functions, let alone dysfunction, Freud remained attentive to the way representation operates with regards to many of his psychoanalytic concepts.



Sigmund Freud Papers, Library of Congress

THE ORIGINS OF PSYCHOANALYSIS

Freud's correspondence with his close friend, confidant, and fellow physician Wilhelm Fliess was key to the development of his psychoanalytic theories. Between December 1892 and May 1897, Freud sent Fliess a series of manuscripts attached to letters, wherein he offered his early thoughts on many concepts including hysteria, melancholia, and the origin of neurosis. Some of these manuscripts contained drawings or iterations of ideas that would be worked and reworked throughout Freud's long career.

MELANCHOLIA, DRAFT G (1895)

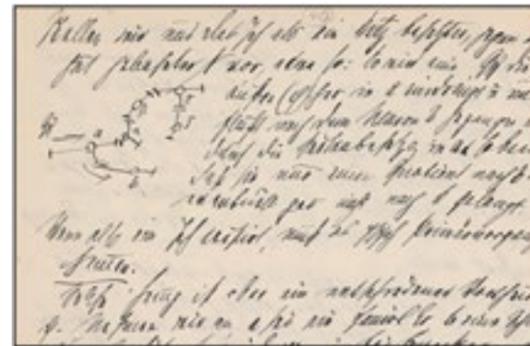
This is one of four drawings that Freud sent to Wilhelm Fliess in an attempt to understand the structure of melancholia (undated, but likely January 7, 1895). "The affect corresponding to melancholia is that of mourning—that is, longing for something lost," Freud writes. "Melancholia consists in mourning over the loss of libido." The draft distinguishes between two main schemas: "The Normal Schema" and "The Sexual Schema." «The Normal Schema," the more difficult to decipher of the two, illustrates how such a loss manifests in two major ways: anxiety neurosis and neurasthenic melancholia. In both cases, sexual energy cannot bind to an object and therefore circulates in perpetuity, causing inversion of the sexual drive and resulting in melancholia. Freud conceptualized melancholia here neurologically, modeling these drawings on a reflex arc – a neural pathway that controls a reflex – in an attempt to isolate and incorporate higher cognitive functions crucial to the development of melancholic personality. The complexity this image conveys may be seen to mirror Freud's tentativeness on the subject. "The affective processes in melancholia," he wrote 15 years later, "are totally unknown to us." However, within two years, Freud was characterizing melancholia as a psychological phenomenon in his well-known paper, "Mourning and Melancholia" (1917).



Sigmund Freud Papers, Library of Congress

INTRODUCTION OF THE EGO (1895)

In his posthumously published Project for a Scientific Psychology, Freud wrote: "Let us picture the ego as a network of cathected neurons well facilitated in relation to one another" in explanation of this image. Here, Freud relies on a neurological model in which the psyche is composed of a series of nerves working in a feedback system – today known as a Hebbian synapse. Notably, this contrasts his later structural depictions of the ego. Freud's drawing renders the ego as the sum of inhibitory and excitatory stimuli that move from one neuron to another, creating pleasure and unpleasure.



Sigmund Freud Papers, Library of Congress

PANEL DISCUSSION

This exhibit is accompanied by a panel discussion, in which noted Freud scholars explored the role of his drawings and art collection in the development of his psychoanalytic theories.

The panel was moderated by Peter Galison (Joseph Pellegrino University Professor, Harvard University), Elizabeth Lunbeck (Professor of the History of Science in Residence, Harvard University), and Nimrod Reitman (Exhibit Guest Curator; Visiting Fellow, Department of the History of Science, Harvard University; Researcher, Department of Literary Studies, Ghent University). The panelists were Caroline Jones (Professor of Art History, and Associate Dean for Strategic Initiatives, School of Architecture and Planning, Massachusetts Institute of Technology), Joseph Koerner (Victor S. Thomas Professor of the History of Art and Architecture; Senior Fellow, Society of Fellows; Harvard University), Andreas Mayer (Senior Researcher, Centre Alexandre Koyré, French National Centre for Scientific Research (CNRS); Professor, École des Hautes Études en Sciences Sociales, Paris) and Diane O'Donoghue (Director, Program for Public Humanities, Tufts University; Visiting Professor of Public Humanities, Brown University).

The original discussion occurred on February 17, 2021 and the recording is available on the exhibit page and the Department of the History of Science's YouTube channel.

GRADUATE STUDENT BENEFITS

This highly successful, visually engaging exhibition has drawn large audiences, offering visitors an interactive experience that a static, place-based exhibit cannot provide. More than 350 people attended the opening Panel Discussion, including several of our own graduate students, as well as psychoanalysts and others from across the US and around the world. It is likely that the format we chose, which was so expertly realized by the Harvard museum staff, will figure importantly in the future of exhibitions. It was not simply a digital replacement for the in-person experience made impossible by the pandemic, but rather, a creative adaptation which encouraged active and personal engagement with the objects. The lessons learned during the staging of this exhibit will be incorporated into future planning, and into teachings for graduate students who are interested in the materiality of science and museum work. This represents an important aspect of the training we offer graduate students, and it is clear from the feedback we received that they found the exhibit and the Panel Discussion fascinating and eye-opening – a valuable model as they plot their own professional futures.

Nimrod Reitman, a postdoctoral visitor to the department, was one of the curators of the exhibit. Staging the exhibit – working with Professors Galison and Lunbeck, and with Harvard Museums of Science and Culture staff – was central to his overall postdoctoral experience. The exhibit was conceived and executed in a non-traditional manner that would not have been possible in the normal course of postdoctoral work, and went beyond what he might have been exposed to in lectures or seminars. In addition, once it became clear that everything would be done online due to the pandemic, he seized the opportunity to reformulate the exhibit. He tackled head-on questions about representation of psychoanalytical material that resonated with one of the discipline's most pressing questions: how can one represent the unrepresentable, or the unconscious. Reitman learned a great deal from this work, which provided him with the practical experience of working with designers, editors, and multiple lending institutions, and prompted him to think creatively about audience interactivity and the communication of ideas to the public – none of which is necessarily part of traditional academic outputs.

PROJECT 2: ARAMONT ARCHIVE WEEK

Prof. Hannah Marcus

In light of travel restrictions due to the COVID-19 pandemic, I proposed an opportunity for graduate students to have a remote “archive trip.” The Aramont Foundation History Beyond the Classroom fund made up to \$1000 per student available to request digitization of archival materials directly related to their dissertation projects.

Students committed to working through the archival materials during the last week of winter break. Every day of that week, all students met on Zoom with the faculty lead for a lunchtime discussion. The cost of delivered lunch for students was covered by Aramont funds. During these lunches, students and the faculty lead discussed strategies for working in archives, note taking in archives, and balancing writing with archival research.

Four students joined the archive week: Tina Wei, Brad Bolman, Kat Poje, and Vi Le.

On the first day, the students introduced their topics and shared images of the documents they had scanned. We talked about how to take notes on archival materials, note management systems, and photo management systems. On the subsequent days, students told the group about their respective projects and about what they’d learned from their sources in the 24 hours since we last met. This provided accountability for working through sources. We then discussed pacing archival research throughout the PhD, publishing on archival work, paleography skills, anxiety about completeness when working in archives, navigating finding aids, identifying archives, and various methodologies of archival sampling.

In addition to archival practices, there was an additional unintended benefit of the format: While much of my research takes place in archives that are also sites of international scholarly community and sociability (ex. Vatican Library, State archives in Venice, etc.), most of these students had only ever worked in archives in isolation. This format provided students with community around archival research that is not typically found in their fields.

COMMENTS FROM PARTICIPANTS

BRAD BOLMAN:

The conversations were a fantastic opportunity for a kind of socialization which has been difficult to come by this year without access to our offices and facilities. Professor Marcus shared examples of her own prior research trips and how to plan research travel to maximize opportunity, a discussion which has been scant in prior years in my graduate program.

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We were encouraged to adopt a research reflection “notebook” at the end of each day of our work and, although I’ve never tried this before, I plan to take up the practice in the future.

In a future year when physical access to facilities is possible, it might be valuable to continue the “virtual” conference while grad students are physically at their research locations. On the other hand, if students can come together in a single place, it would be great to have shared time together for writing before having lunch.

I cannot thank the donors enough for supporting this event, they have my sincere gratitude!

VI LE:

I learnt tips about taking and organizing notes, reading handwriting, journaling... It was also comforting to know that others also share my anxiety about missing something important in the archive or not knowing when the work is actually complete. I realized I should build a habit of attending to my research every day.

My approach to archival research is now much more structured. I’ve also started to journal my reflections each day on what I have looked at. I liked the openness and spontaneity of our conversations. I liked how we went beyond the archive to discuss other things that are the purpose of doing archival work (research, publication, getting a job, etc).

Thank you so much for making it possible for us to obtain digitized archival materials and have productive virtual lunch hours. This was so helpful in keeping me motivated and focused while in isolation.

KAT POJE:

Primary source documents that are crucial for my research and otherwise would have been inaccessible; I was grateful for the support in prioritizing primary source reading, a challenge when balancing teaching and writing. The exercise was an introduction to different approaches to primary source locating, archive note taking, and research and teaching workflows, and gave me a better understanding of some of my colleagues' projects. Hearing professionalization tips from a scholar with recent experience transitioning from graduate school to a tenure-track professorship was incredibly helpful.

The week provided a wonderful sense of community around archival challenges and crowd-sourcing tips. Most of my archival work is virtual and thus somewhat isolating due to the pandemic. The chance to share my research materials and my concerns and hear the same from others was a huge boost in a difficult time. I am also inspired to create future opportunities for archival discussions with other graduate students.

I have been reluctant to take on deciphering the handwritten 19th century documents I've found in my research; learning from a scholar whose work requires paleographic patience encouraged me to go back to these sources.

I especially appreciated the fact that the lunch hour check in motivated work but gave each participant more freedom than synchronous engagement across an entire day would have.

This felt like an opportunity not only to gain access to valuable research materials but a rare chance to also build community and professional skills. The educational aspects of the week were thus for me the highlight. I am very grateful for the Aramont Foundation's generous support of this unique experience.

TINA WEI:

It was invaluable to receive funding for digitization services. These documents allow me to continue my archival research while my primary repositories at Purdue University are closed down due to the pandemic. In addition, the daily check-ins allowed me to troubleshoot archival questions in the company of my peers and to receive crucial feedback from Hannah Marcus.

In my experience in our department, I have not had any other opportunities to gather with people to discuss archival research with this intensity. This experience gave me a lot of insights into areas where my archival training is lacking, such as in my ability to navigate finding aids, collate information, decipher handwriting, etc. Additionally, learning how to plan out my archival research timelines is a skill I will use for the remainder of my PhD experience.

Thank you so much for this amazing opportunity! It was the highlight of my month to be able to jumpstart my research in the new year in community with other graduate students and a dedicated faculty member.

PROJECT 3: MATERIAL CULTURE ANALYSIS IN THE HISTORY OF TECHNOLOGY

Prof. Matt Hersch, Spring 2021

This course enrolled three students, who, along with the instructor, participated in the exercise. As enrollment did not reach the course cap, course activities were completed without the full expenditure of the funds awarded. A companion undergraduate course in the History of Technology, HISTSCI 189 (The World We Made: Technology and Society), was taught simultaneously.

The graduate seminar HISTCI 283 (Sources and Methods in the History of Technology) has, in the past, included a hands-on activity involving the in-person assessment, operation, and disassembly of an archaic technological artifact – either in class or in the community. In lieu of this activity, the instructor employed grant funds to purchase and ship a used, obsolete, but working device to each member of the seminar to study and utilize at home. Given the small size of the class, a single type of technology was chosen: photographic apparatus. The artifacts chosen were different for each student. They were matched to their interests and historically significant, but not worthy of museum preservation or rare enough to be expensive to acquire. As film technology is in disuse, most of these artifacts were purchased and shipped for approximately \$100 from Ebay. Students had the option of returning or retaining the artifacts for future use or study, but unanimously chose to keep and continue researching them.

The artifacts included a 1911 Kodak Brownie Model 2A (roll film); a 1926 Bell & Howell Filmo 70A (16mm silent motion picture reel, shown here with Robert Capa); a 1972 Polaroid SX-70 (internal dye diffusion transfer); and a 1980 Nikon Nikonos IV-A (35mm cartridge, waterproof, originally developed by Jacques Cousteau) (researched by the instructor).

Students and the instructor conducted research on these devices and attempted to use them, and then prepared illustrated oral reports based upon their research – which they shared in class remotely via Zoom on March 8, 2021 (see below). The research performed by students was extraordinary: They not only restored the cameras to working function and used them, but also conducted research about both the devices and their specific models, using local resources where possible. The inclusion of a Polaroid SX-70 camera in the exercise allowed one student to use Polaroid Corporation archives at Harvard Libraries, while another student discovered, through his research, that the specific Bell & Howell Filmo 70A camera he received had once been United States Army property, employed in the Manhattan Project to document activities at the Clinton Engineering Works in Oak Ridge, Tennessee in 1943 – making it a previously undiscovered valuable historical artifact. This student discovered declassified photographs likely taken with this camera and screened them in class.

As described in the proposal, students in the related Spring 2020 graduate seminar, HISTSCI 288 (The Digital Age: Sources and Methods), were assigned to gain fluency in the use of obsolete computer systems which, due to the campus shutdown and lack of funds available to support this activity, occurred as a virtual exercise. Students used software to emulate the operation of older hardware and operating systems on their own disparate and sometime inadequate PCs. To better facilitate this exercise in the future, a new, inexpensive x86 CPU was obtained for class use, for the emulation of obsolete operating systems using software like VirtualBox, Gemulator, and SALTO – an emulator for Xerox's 1973 Alto workstation.

The x86 CPU chosen, a Hewlett-Packard Slimline 290-P0043W, was purchased for \$179. It is a rudimentary but user-serviceable model known for its amenability to customized component upgrades, which will be integrated into HISTCI 288 as a course activity.

Material culture is an important and growing area of research interest in the history of technology. COVID-19 has made it significantly more difficult for graduate education to employ material culture, preventing the in-person examination and historical analysis of technological artifacts, both in the classroom and outside of it. Not only did the exercises in HISTCI 283 compensate for the lack of in-person instruction, they created new opportunities for students to engage in personally-directed, but faculty-mentored, research. Reflecting on works such as Eugene Ferguson’s *Engineering and the Mind’s Eye* (Cambridge: MIT Press, 1992), students considered the challenges of engineering and industrial design, the marketing of technologies, and their relationship to culture more broadly. Without funding, the material culture components of HISTSCI 283 would likely have been unavailable to students.

Students were engaged and appreciative of the opportunity. Costing approximately \$100 per student, plus a small amount of instructor research time, this was the most cost-effective research exercise the instructor has ever conducted with graduate and advanced undergraduate students.

Students developed knowledge of historical technologies, the inventive process, the intricacies and compromises in industrial design, a newfound appreciation for older devices, and expressed interest in pursuing photographic activities. Personal investigation of technological artifacts should be employed in all future administrations of HISTSCI 283, and the obsolete computer exercise of HISTSCI 288 should be continued as well.

COMMENTS FROM PARTICIPANTS

JADYN BRYDEN:

Being able to hold a piece of history in my hand gave me a more personal experience learning about the past. It was so engaging and fun to interact with a historical artifact and figure out how it would have been used and handled in the past by exploring in a hands-on way.

KEVIN TROY:

This was one of the most enjoyable and rewarding assignments I have had as a graduate student. Especially in a class about the history of technology, there is a differentiated engagement associated with being able to physically inspect an artifact. Moreover, I was able to use some of the markings on the artifact I was given to associate it with a particular time and place of historical significance (the camera seems to have been used by the Manhattan Project in the location now known as Oak Ridge). Discovering this was genuinely thrilling.

ADAM LONGENBACH:

For me, the “Material Challenge” underscored the difference between having an intellectual understanding of a technology and holding the technical object in your hands and attempting to put it to use. This difference was evident in my material challenge: the 1972 Polaroid SX-70 Land Camera. The SX-70 Land Camera greatly advanced one’s ability to produce “instant photography” — to experience a view and in the next moment hold a photo of that view in your hands. It was described by its inventor, Edwin Land, as being “as easy as taking your wallet from your pocket, opening and closing it, and that’s all you would need to get a picture.” Of course, Land’s quote from 1973 takes on an entirely different meaning in 2021 when one can produce any number of pictures with a smart phone with such ease that even my four-year-old nephew mistakes himself for a photographer. Learning how to operate the SX-70 Land Camera, however, punctuated how difficult it was to ‘instantly’ produce an image in the early 1970s relative to today. As ‘simplified’ as the SX-70 was for its time, the camera requires one to develop a certain expertise with the many nuances of the technology—how to properly load the film, how to hold the camera, how to focus the lens and optimize the exposure, how to use the viewfinder, and so on. This experience was significant for me as a PhD student who works on topics in early twentieth-century visual culture. The material challenge confirmed the unique ways in which optical technologies require their operators to cultivate both a technical aptitude and a new subjectivity, one which understands the advantages and drawbacks of mediating one’s vision through this or that optical device. As I continue to study early-twentieth century optical technologies for my dissertation research, I will undoubtedly incorporate the ‘lessons learned’ of the Material Challenge into my methodology, being sure to more roundly study the technical objects I wish to historicize by actually attempting to use them, if only to test my assumptions about what it meant in the past to see the world through technology.

PROJECT 4: HISTORY BEYOND THE CLASSROOM IN THE PANDEMIC: HISTORY OF SCIENCE 304A/B

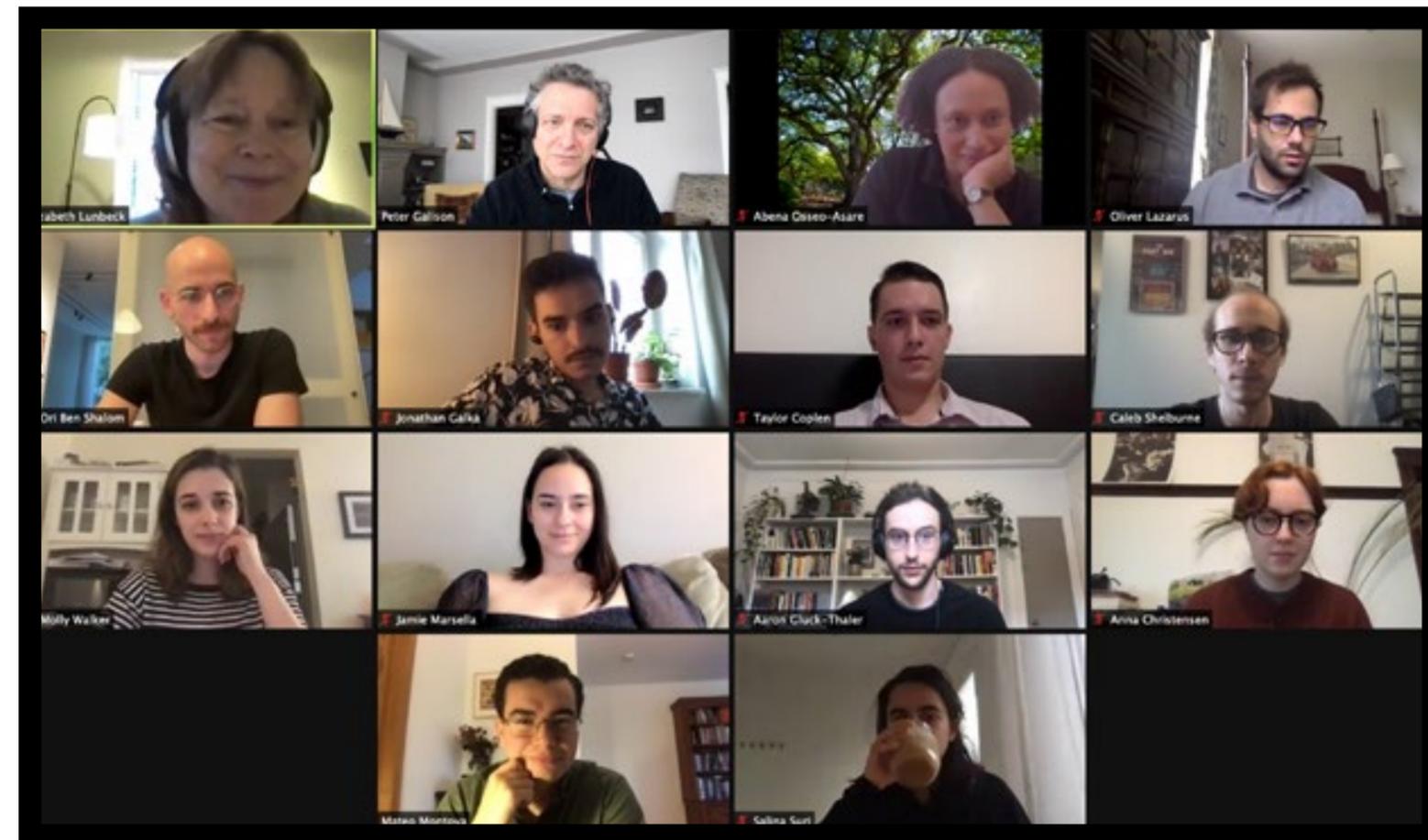
Prof. Elizabeth Lunbeck and Prof. Peter Galison

In Spring 2020, it became clear that the pandemic would shut down travel and in-person learning for the foreseeable future. Professors Peter Galison and Elizabeth Lunbeck were determined to prevent it from also shuttering History Beyond the Classroom. Seeing opportunity in the midst of disaster, they devised a variation on the well-established and highly successful program's format, locating the "Beyond" in Zoom-mediated cyberspace.

The course that resulted, "History Beyond the Classroom: Foundational Discussion about Research," brought expert colleagues from around the world to eight seminars throughout the 2020-2021 academic year, in which all first and second-year graduate students in the department participated. The guests were invited to speak about the methods and issues that they see as central to contemporary and developing work in history of science, as well as their own intellectual and professional journeys. Students were provided with copies of the guests' books; then, having read and discussed them among themselves, were charged with leading the seminars – which they did brilliantly. Four times each semester, faculty and students – scattered far and wide by the pandemic – gathered on a Zoom screen to engage directly with well-known experts. During these meetings, they probed the sorts of issues that are rarely asked but are of burning interest to young scholars: "How did you define your area of specialization?" "What difficulties – methodological, practical, emotional – did you face along the way?" "How does one adjust to or, alternately, influence the field's changing norms and preoccupations?" "What has been the afterlife of the particular book under scrutiny?"

Our discussions of the arc of the scholars' careers were particularly lively and engaging for students. Highlighting the uneven mix of chance, contingency, and opportunity on the one hand, and the sometimes-frustrated intellectual and methodological ambitions on the other, as well as the pathways to dead ends that characterize many an academic career, our guests offered students a privileged window into the often-bumpy and unpredictable process of getting from where they are as beginning graduate students to the positions of authority and influence their professors occupy.

The course turned a major disruption in students' training into the opportunity for them to meet senior scholars in a small-group format, and to sustain a sense of their own pandemic-imperiled community in the process. Students reported that the seminars stretched their intellectual horizons, nurtured their ambitions, and provided them with the sort of communal experience that is so critical to graduate education – and of which they had been so cruelly deprived due to the pandemic. We, the course instructors, absolutely loved developing and teaching this very special course.



Peter Galison, 2021

SEMINAR SCHEDULE

Fall 2020 Semester:

SEPTEMBER 15: Lorraine Daston, Max Planck Institute for the History of Science; University of Chicago-*Objectivity* (co-authored with Peter Galison)

OCTOBER 6: Ruha Benjamin, Princeton University, *Race after Technology*

OCTOBER 27: Hasok Chang, University of Cambridge, *Inventing Temperature*

NOVEMBER 17: Deborah Coen, Yale University, *Climate in Motion*

Spring 2021 Semester:

JANUARY 26: Michael Gordin, Princeton University, *Einstein in Bohemia*

FEBRUARY 16: Michelle Murphy, University of Toronto, *The Economization of Life*

MARCH 30: Sarah Igo, Vanderbilt University, *The Known Citizen: A History of Privacy in Modern America*

APRIL 20: Abena Dove Osseo-Asare, University of Texas, Austin, *Atomic Junction*



A FEW EXCERPTS FROM OUR STUDENTS' ASSESSMENTS OF HISTORY BEYOND THE CLASSROOM

AARON GLUCK-THALER:

The History Beyond the Classroom seminar was a personal highlight of this past year. Although I have become accustomed to reading books collectively in graduate school, this was the first course I have taken that afforded students the opportunity to engage directly with the author of a given book. Hearing how each author researched their topic gave me a stronger sense of how scholarship is actually produced and helped reveal how fledging research interests are transformed into polished scholarship. The range of concerns that visitors brought to the seminar—from histories of climate change to privacy—further impressed on me an appreciation of how historical scholarship can intervene in contemporary debates. [Engaging with the visitors] has pushed my research in new and exciting directions—particularly towards a more central accounting of the historical relationship between race and surveillance and a greater sensitivity to the role of public debate in shaping notions of privacy.

I am especially grateful for the sense of community that this seminar has helped cultivate among first and second year history of science PhD students in these distanced times. At the beginning of the COVID-19 pandemic, I relocated to my home city of Montreal. Since then, like many of my peers, I have been missing the informal conversations that we once had around the department. I was pleased to see how History Beyond the Classroom discussions carried well beyond our virtual sessions. On multiple occasions, students came together in supplemental Zoom gatherings to further unpack a given book and more generally chat about the sorts of scholars that we hope to become. I am appreciative that, despite distance, a sense of fellowship has been both sustained and deepened through the course.

MOLLY WALKER:

I've been so grateful for History Beyond the Classroom! Because I am preparing for my general exams in May, most of my other coursework this semester is independent. And as I currently live alone during a pandemic, this can at times be really lonely work. History Beyond the Classroom provides a vital tether to the department and to my friends and classmates. It also provides a chance to take a step back from the very narrow fields I'm studying and reflect upon how my work might one day fit into the larger discipline of History of Science. I appreciate the opportunity to hear about the paths guest speakers have taken in their careers and love hearing them speculate about their visions for the future of the field.

When I was deciding between graduate programs, I picked Harvard because I believed that the History of Science Department would encourage me to think creatively and push my dissertation in directions I couldn't anticipate. Even in the midst of a pandemic, this class has introduced me to ideas I wouldn't have encountered on my own! Thank you so much for making this possible!

ORI BEN SHALOM:

Entering into a PhD program is not always easy. In my case, it might have been even more difficult than usual: as an Israeli citizen, and due to the pandemic, I could not have obtained a student visa, and therefore had to spend the year studying from Tel Aviv. However, participating in the monthly meetings of the “History Beyond the Classroom” seminar was a way for me to nevertheless meet my cohort, work together with them, and create the kind of network necessary for going through a PhD. Further, as a new student to the discipline of the history of science (I was trained in European history), getting to know prominent scholars in the field has been very helpful in understanding it.

MATEO MONTOYA:

History Beyond the Classroom (HS 304A/B) has been a great opportunity to engage with historians of science and their work. The different books we read exemplified diverse avenues of the history of science conceived broadly—from contemporary analysis of the amalgamation of race and technology in Ruha Benjamin’s *Race after Technology* to the history of climate science in the Hapsburg Empire in Deborah Coen’s *Climate in Motion*, to a historicized reprise of Einstein’s figure and life in Michael Gordin’s *Einstein in Bohemia*. This is the history of science at its best: it challenged me to consider the role and function of what we conceive as science across geography and time. It also offered a great opportunity to get more familiar with the research and interests of my program and cohort mates as they responded to and questioned our speakers.

In addition, the books in this class were some of the only ones that I read in print this year, which made them all the more enjoyable and a nice reprieve from a year spent on screens!

In sum, the course met a need for stimulating intellectual conversation, engagement, and connection while serving as well as an antidote to the loneliness and isolation of pandemic-era life. The instructors and students alike have judged it an overwhelming success.

OSASE OMORUYI:

Over this past academic year, I have had an incredible experience in “History Beyond the Classroom”, where I was afforded the opportunity to read and study from a wide array of scholars across the field. Though I originally came to Harvard to pursue a Ph.D in Astronomy, I have endeavored to learn more about astronomy’s sociopolitical context through Harvard’s History of Science Master’s program. Despite the difficulties of distanced learning through the ongoing COVID-19 pandemic, this class has not only allowed me to prioritize using this time to read closely and broadly, but also given me the opportunity to critically engage with the scholars I read. I am immensely grateful for the generous Aramont “Graduate Education Beyond the Classroom” fund for books, which ensured that I had access to each scholar’s work, regardless of any financial barriers. Lastly, I am thankful for the support from my professors to help keep me involved in class despite my persistent connectivity difficulties over the course of the year.

