Communicating Climate Knowledge: Proxies, Processes, Politics

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CA☆ FORUM ON ANTHROPOLOGY IN PUBLIC

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This forum article is the product of interdisciplinary discussion at a conference on climate histories held in Cambridge, United Kingdom, in early 2011, with the specific aim of building a network around the issue of communicating cultural knowledge of environmental change. The lead articles, by Kirsten Hastrup as an anthropologist and Simon Schaffer as a historian of science, highlight the role of agents and proxies. These are followed by five interdisciplinary commentaries, which engage with the lead articles through new ethnographic material, and a set of shorter commentaries by leading scholars of different disciplines. Finally, the lead authors respond to the discussion. In this debate, climate change does not emerge as a single preformed "problem." Rather, different climate knowledges appear as products of particular networks and agencies. Just as the identification of proxies creates agents (ice, mountains, informants) by inserting them into new networks, we hope that these cross-disciplinary exchanges will produce further conversations and new approaches to action.

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1. This forum article was coordinated and edited by Hildegard Diemberger, with the assistance of Richard Irvine and Barbara Bodenhorn.

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Prelude

Charles F. Kennel

Understanding the natural impacts of climate change requires far more than climate science; meteorology, ecology, biology, hydrology, and agricultural and environmental science are also needed. One has to go even farther to understand the human impacts of climate change. This challenge has yet to call forth the varied and vast panoply of social scientists needed to address issues that are actually far more complex than the changing climate itself. Historians, resource economists, geographers, anthropologists, and many others have roles to play in assessing the human impacts of climate change.

In the end, it will all come down to public communication. Decisions will be neither made nor implemented without public understanding. And the most important question for each and every individual in the public is, What will climate change mean for the people and things I care about? Here is where the human disciplines should shine.

David Sneath

As Charles Kennel points out, current debates surrounding "climate change" have given a new sense of urgency to cross-cultural study of the environment. This forum article builds on the interdisciplinary discussions at a conference on climate histories held in Cambridge and supported by a United Kingdom Arts and Humanities Research Council (AHRC) grant[2] specifically focused on building a network around these issues. We found strong mutual interest in agents and proxies, represented by the lead articles by Kirsten Hastrup as an anthropologist and Simon Schaffer as a historian of science. These are followed by five interdisciplinary commentaries, which engage with the lead articles through new ethnographic material, and shorter commentaries by leading scholars of different disciplines. Finally, we have responses by the two lead-article authors. As Marilyn Strathern points out, these treatments do not show climate change as a single preformed "problem." Rather, different climate knowledges appear as products of particular networks and agencies. Just as the identification of proxies creates agents (ice, mountains, informants) by inserting them into new networks, we hope that these cross-disciplinary exchanges will produce further conversations and new formulations. A fuller version of Hastrup's paper, as well as other papers emerging from the climate histories conference, will appear in a special issue of *Cambridge Anthropology*, new series 1(3).

2. The conference was supported by the Centre for Research in the Arts, Social Sciences and Humanities, University of Cambridge, and funded by the AHRC networking grant "Climate Histories: Communicating Cultural Knowledge of Climate Change."

Lead Articles

The Icy Breath: Modalities of Climate Knowledge in the Arctic

Kirsten Hastrup

In the Arctic, human life takes place under the breath of ice. Depending on where one is, it may be a more or less permanent presence, but it is always in the horizon. It impinges on the imagination, creates social dramas, and affords a wildlife from which the hunters live. I would suggest that the ice is its own argument; it is not for us to argue its case—that would be only a faint echo of its own powerful impression on the Arctic world. This takes us farther than seeing the ice as an actor in a Latourian sense. The ice certainly *does* something in the Arctic, it is not simply a placeholder (see Latour 2005:154); but as an agent it has also infiltrated all representations of the Arctic and become a focus point in a multiplicity of histories and theories about the environment. My reflections are grounded in my fieldwork in the Thule District of Northwest Greenland over the past five years (Hastrup 2009*a*, 2009*b*, 2010, forthcoming). For the people living there, the current changes in weather, wind, and, most poignantly, the ice have greatly affected the horizon of certainty within which they can act. Their future has become increasingly uncertain because the space for action has shrunk. It is this spatial dimension of climate history that I explore here. I do so by briefly addressing the dominant modalities of knowing the ice and appropriating the secrets of a long climate history. Implicitly, I am going along with David Turnbull's (2003:4) notion of a "knowledge space" as an "interactive, contingent assemblage of space and knowledge, sustained and created by social labour." This implies that knowledge is located and emergent; consequently, knowledge of the Arctic is formatted under the breath of ice, as encountered and explored.

Sila: The Breath of Ice

Let us start by considering the ice as seen from within the Arctic landscape, where it is closely tied up with the notion of *sila*. The term refers to both weather and climate, which were not separated until recently, when climate change as perceived by the Intergovernmental Panel on Climate Change entered a global vocabulary. But the meaning of *sila* runs deeper, because it is also understood as the breath of life, the reason for seasonal and other changes, and the fundamental principle underlying the natural world and its comprehensive "mind." "*Sila* is manifest in each and every person. It is an all-pervading, life-giving force connecting a person with the rhythms of the universe, and integrating the self with the natural world" (Nuttall 2009:299). The comprehensive nature of *sila* makes it the most significant memento about the mag-

nitude of the landscape, and there can be no escaping from it, only a sensation of temporary emergence from topography.

Human agency and even subjectivity have to be constantly reclaimed in a landscape of such momentousness, within which the manifest insignificance of people displaces them from center stage, where the ice becomes the main actor. Yet within the framework of *sila* and the landscape as a whole, people naturally move about and add their own stories to the space within which they find themselves. Whether the story is about hunting, traveling, growing up, or the current climate changes, it always seems to center on the agency of ice. Aqqaluk Lynge, Chair of the Inuit Circumpolar Council (ICC), addressed the Royal Scottish Geographical Society:

> When you think of Greenland, you likely think of glaciers and icebergs, and more generally, of ice. I hope that after this talk you will also think of my people and our intimate relationship *with* the ice. In the Inuit language, we use the word *sila* for ice. But *sila* also means much more than ice. It also means weather, climate, environment, sky, and indeed, the universe. So when Inuit experience changes in the ice, as we are now due to the first effects of climate change, this is more than "just" a change in ice conditions and climate, it is a change in our basic environment and indeed, our universe (Lynge 2009).

Lynge elaborates on the changes taking place and the fact that the Inuit have lived in northeastern Russia, Alaska, Canada, and Greenland since long before these places were so named in consequence of domination and colonization. After introducing his own background in the Disko Bay area and the fact that UNESCO has named the Ice-Fjord a world heritage site, he continued,

> One must respect, and sometimes fear ice. It is the giver of life for us. Fish are drawn to the nutrient-rich waters at the base of the freshwater icebergs, which in turn, bring seabirds and seals. I was once hunting near a most magnificent iceberg possessing unimaginable colours and peaks and towers rising high into the beautiful blue sky. At the time I imagined it to be a large scale model of the Sydney Opera House. I was, luckily, *not* in a kayak but in a small motorized boat along with a friend. Even luckier, there was another motorized boat and two other companions in it. The *opera house* towering above us suddenly began to heave, and groan, and sway. I had never been so dangerously close to a calving iceberg before. We powered away. But only a minute later, my motor stalled. The other boat saw us in trouble, swung back, and threw us a rope and pulled us slowly away from the iceberg that was now rocking back towards us, not more than 50 metres away. I kept pulling the starter rope on the engine. Over and over again. Finally, it sputtered and away we went. I looked back and a huge rolling wave came at us and under us, propelling us forward. Again fortunate, the engine picked up speed and away we raced. When I dared slow down the boat, we looked back and saw nothing but thousands of small icebergs and floating freshwater pieces of ice where the *opera house* once stood (Lynge 2009).

The reason for relating this long quote from the ICC chair's address is its almost emblematic character as an Arctic story; starting out from the timeless *sila* and the plight of the people under the current climate change, it finally becomes an intense drama of a personal battle with the ice.

The shattered iceberg in Lynge's wake is a strong image of the elusiveness of place, which is a remarkable feature of the Arctic space and of the stories it generates. Massey (2005:130) speaks of "places not as points or areas on maps, but as integrations of space and time; as spatio-temporal events." Places emerge when something happens. Places may be named and marked by cairns, hunting events, manslaughter, glacier bursts, or bears, but they are always the result of emerging stories, accidental encounters, and movements along lines of promise involving a constant negotiation between things human and things nonhuman. This "event of place" permeates Lynge's account; he could not remain at the point from where he set out to speak: the timeless *sila*. The argument produced by the shattering iceberg created its own momentous place, where Lynge was unable to argue back and simply had to flee.

Science: Assemblages of Knowledge

Against the elusiveness of ice as experienced, we might be tempted to posit science as a purveyor of solid and unified knowledge of the ice. This is not necessarily so, however, given science's nature as an assemblage. In 1837, the Swiss scientist Agassiz proposed a glacial theory, suggesting that the entire Northern Hemisphere had once been covered in ice, of which the Alpine glaciers were remnants. The Ice Age was thus identified retrospectively from empirical observations, and this was not easily accepted. Yet gradually, the ice was recognized as a repository of climate histories in the depth of time. The fossils from earlier ages were strong mementos of the long-term changes in the affordances of the north.

In Greenland, the earliest scientific investigations of the ice were by Hinrich Rink in the mid-nineteenth century. His observations of the ice (both the icecap and floating icebergs) led him to conclude that glaciers were outlets from the icecap, under ever more pressure from each year's snow. He also identified the subglacial watercourses running under this ice, and he

> was informed by the natives that this had always been a well-known fact to them. They say that the more abundant the supply of water, and the more violent its motion is in the streams of fresh water which takes the form of wells in the front of the glacier abutting the sea, the more effective will the glacier be in producing icebergs. (Rink 1974 [1877]:361)

Planetary science and local observations supported each other. This is one reason for pausing at Rink's work; another is his contribution to the general acceptance of the glacial theory. What is more, it is evidence of the profound knowledge of

nature's stories entertained by hunters, who also knew the ice fjords to be productive as a hunting ground.

It was only later that a view of science as set apart from "local" knowledge emerged. In the Arctic, a major instance was provided by International Geophysical Year (IGY) 1957–1958, a successor to the two International Polar Years in 1882–1883 and 1932–1933. The two polar years had facilitated international collaboration in a range of domains, and important advances were made in polar biology, meteorology, and geology. In the wake of these efforts, climate knowledge grew and solidified. With the IGY, this growth was strongly overlaid with both Cold War politics and an effort to keep politics out of research. By the end of the Second World War, the geography of the Earth had been defined by national and international boundaries, and seven states had even more or less occupied Antarctica (Collis and Dodds 2008:558ff). After the IGY, an Antarctic Treaty was signed in 1959 in which the parties declared Antarctica a zone of peace and a "continent for science" (Collis and Dodds 2008:563). Even so, science had become part of the military-industrial complex.

Meanwhile, civilian scientists had noted that "the Arctic affords a straight line attack to the Eurasian centres of our potential enemy, and because of that if for no other reason, we must give full consideration to the best [scientific] exploitation of the Polar regions" (geographer Paul Siple, quoted in Collis and Dodds 2008:566). The U.S. IGY program in the Arctic was to take this seriously by encapsulating parts of Alaska, Canada, and Greenland. In Greenland, it was the Thule region that suffered, because the airbase (established in 1953) was enlarged under the ice, and enormous hunting grounds were declared off limits. Meanwhile, the science of the ice solidified in isolation from the locals, who had to resettle elsewhere in the district.

What historians of science have now begun to demonstrate is that science never speaks in one voice; there is no unified science, as opposed to a unified native point of view—even though that idea was widely entertained during the Cold War, even in anthropology. This has recently been shown for Cold War glaciology in Sweden, always a hotspot for ice studies (Sörlin 2009). Advancement in the field was shaped in a battle between divergent agendas and direct contradictions in depicting the causes of climate change.

The internal scientific disputes would alienate Rink's "natives" even more from the scientists, and it is still difficult to close the gap—even in an age where global climate change is on everybody's lips. Also, in the new Thule (Qaanaaq), science is omnipresent: geophysicists, biologists, technicians, glaciologists, and anthropologists tread on one another's toes, at least during the spring and summer seasons, when the light allows one to work day and night and the cold is bearable. More often than not, the scientists work with local hunters, whose skills at sledging are necessary for moving around on the sea ice or across ancient sledge routes on the glaciers. There is mostly good will and collaboration—it is well-paid work for the hunters—but no real dialogue about the deeper meanings of the unfolding dramas on and with the ice.

The anthropologist, too, has to go with the hunters to understand what it means to navigate the ice and cannot but marvel at their skills, not to mention their generosity with time and stories. In May 2010, when I joined a party of hunters who were going to the ice edge for walrus, I had a chance to talk at length with a seasoned hunter about the manifest and very threatening changes in local weather conditions. During our conversation, he voiced one of his own theories about the ongoing climate change. He suggested rather vociferously that the ice-core drillings carried out by scientists on the icecap were at the base of all of the changes.

> They [the glaciologists] are destroying the icecap. Clearly, they have now drilled in four different places, and obviously the meltdown starts there. A lot of water comes out from under the ice and makes the rest slide. The Americans started it all by carving out large under-ice roads. They wanted to drill all the way towards South Greenland. They were mad.

He had a (scientifically established) point about water running under the ice and speeding up the glacier movement—as Rink had been told by other locals 150 years ago. It is hardly an outcome of the ice-core drillings, yet it still testifies to the assemblage of knowledge and space.

Science, too, creates climate histories that are spatially anchored and operate under the icy breath of the landscape. The most prominent history today is created by the practices of the ice-core drillers on the Greenlandic ice cap who, by retrieving an ice archive going back 100,000 years, give humankind back a long-lost memory of changing climates.

Refrain: The Ice as Argument

To end this paper, I invoke the notion of "the refrain" from the work of Deleuze and Guattari. They define a refrain as "any aggregate of matters of expression that draws a territory and develops into territorial motifs and landscapes" (Deleuze and Guattari 2004:356). The notion derives from assemblages that are dominated by sound, such as the singing of birds, or—one might add—the ringing of church bells or the voices flowing out of minarets at particular times, but refrains can be optical, gestural, architectural, and much more. The point is that the refrain "holds together" the heterogeneous elements of the territory; it is the refrain itself that affords it a sense of consistency.

In the Arctic, the refrain rests with the ice. It is the ice that holds together the environment or—indeed—splits it up, and it provides the leitmotif of poetry, story, and science. The ice offers a peculiar combination of extension and intension; of vastness of vision, extreme climatic changes, sounds of wind and breaking ice, thunders of calving glaciers; of a particular luminosity; of confined spaces, muted emotions, level human voices, barking dogs, and bursts of laughter amid total silence. The refrain assembles the multiple histories of weather and

climate, people and places in the Arctic, where ice is an all-pervasive social ontology (Bravo 2010).

The ice is not to be argued for or against, notwithstanding the multiple figures in which it emerges and however many elusive places it throws together. The ice is its own argument in complex ways; it is an actor in the human-nonhuman network as well as in the hunter-scientist relationship. Whatever climate history one wants to tell, it begins and ends with the ice. The ice holds together the territorial motifs; it is a figure that configures the whole—at least so far. Life itself emerges under its breath.

Public Trials and Climate Shows

Simon Schaffer

Certain kinds of sciences have long been celebrated for their ability to engage with remote entities, to produce reliable and effective records, proxies, and accounts, and to shift these so that they can be experienced directly, so as to direct and change the deportment of entire populations. It has become common to understand this process as a kind of mobilization, a capacity both to shift and to activate. Yet, as in the case of climatology, it is insistently urged that such sciences cannot now effectively shift, nor can they activate, agents of the ecological cause. It is worth reflecting on how this problem has been understood. The late Douglas Adams, an astute observer of public science, once proposed a useful labor-saving device. Just as automatic dishwashers remove the tedium of cleaning up after meals, so Adams's "electric monk" would perform the highly demanding work of believing all the things in which modern citizens are expected to have faith (Adams 1987:3). Electric monks matter in current climatology because each citizen has apparently become a Doubting Thomas. How hard it now seems to provide proxies that win over their public with confidence and security. There is a range of puzzles in making sense of how such public trials might work.

First, it is thought that they do not work properly because of a lack of deference. But the problem is rather that there are too many different and often contradictory sources of authority, not that there are none. Second, it is thought that this is a new problem, without any precedent in the past of the sciences and their public performance. But this is amnesia, and there is a very long history of enterprises that had to make sense of making a public and then making a place where the public could be shown the sciences and accept their lessons. Last, it is thought that once upon a time there was a highly deferential public and that recently this has collapsed. But in fact this is nostalgia, the false idea of a golden age when sciences' publics meekly accepted whatever experts said (Shapin 2004).

All these moves seem to be in play, for example, in the visionary ecoscientist James Lovelock's reflections at the Royal Society in 2007 on humans' "slow learning process about our relationship with the Earth" (Lovelock 2007). Lovelock holds that Gaia has no special interest in preserving humans. Mobilization and its failings generate startling politics. Lovelock judges humans too dim and errant to cope. So in recent interviews, he recalls how "the moment the war actually started, everyone pulled together and made all the sacrifices necessary" (Lovelock 2009:128). According to Lovelock, we have to give up on democracy in the name of what his science wants to mobilize us to do:

> We need a more authoritative world. We've become a sort of cheeky, egalitarian world where everyone can have their say. It's all very well, but there are certain circumstances—a war is a typical example—where you can't do that. You've got to have a few people with authority who you trust who are running it. . . . I have a feeling that climate change may be an issue as severe as a war. It may be necessary to put democracy on hold for a while. (Lovelock 2010).

A stark choice is on offer: tyranny (the sciences' expert rule) or extinction (the sciences' expert prophecy). The challenge of this choice is especially pressing when the apparent source of authoritative material is judged remote, socially, geographically, and temporally. The work of the sciences is then to shift between distant sites and make materials work when they arrive (Latour 2009). Consider, as telling examples, the histories of, and histories made at, mountaintops. Mountain science has been a permanent enterprise in climatology since its inception. One linchpin of that science, thanks to the astonishing projects of Dave Keeling, has been an observatory built in 1956 atop the Hawai'ian volcanic peak Mauna Loa. The construction of such specially confined places from which the world can be moved is a major feature of modern sciences (Fleming 1998:126–127). This is a process of withdrawal and seclusion, the permanent search for secure sites that somehow could let nature in by keeping society out (Bigg, Aubin, and Felsch 2009). To undermine the credit of materials assembled on such a mountain observatory, it is necessary to point to the unwonted agents (whether ideological or atmospheric) that might penetrate the site's confinement. Experience gathered in these kinds of ways by putatively reliable delegates on distant mountains has a long history in Euro-American cultures. To inaugurate a visionary project, one climbs such a mountain. Ever since the ascents of Ararat, Sinai, Pisgah, and the Mount of Temptation, since the elevated journeys of Rousseau, Saussure, Schiller, and Humboldt, these have been the heights whence the climate of the future might be glimpsed (Macfarlane 2004; Rudwick 2005:21–22).

In 1807, the Andean peak of Chimborazo was displayed by Alexander von Humboldt and his Parisian collaborators in exquisitely measured systems of forces and populations. The aim was to launch a new science of the globe with climatology as principal theme (Dettelbach 1996:292–293). Proxies for these peaks, physical and eschatological, entered European visual culture. They soon appeared in cities as pan-

oramas (Bigg 2007). In the 1850s, hundreds of thousands of Londoners saw public displays of the ascent of Mont Blanc, accompanied by souvenirs and replicas (Altick 1978:474–478). As Humboldt urged, such representations could bring mountain peaks to metropolitan audiences by artfully designed proxies. "An enchanting effect might be produced by a characteristic delineation of nature, sketched on the rugged declivities of the Himalaya and the Cordilleras," he wrote in *Kosmos*; "the spectator, enclosed as it were in a magical circle, and wholly removed from all the disturbing influences of reality, may the more easily fancy that he is actually surrounded by a foreign scene" (Humboldt 1849:457).

Both panoramas and peaks played crucial roles in this enterprise. The major exhibitions of the later nineteenth and early twentieth centuries helped define the term "scientific instrument" as indispensable hardware and "human evolution" as an account of global history. Sometimes such manifestations helped define the scope of the sciences; sometimes they were sites where conflicts over that scope and authority were conducted. The master of this late Victorian public science was the Royal Institution professor John Tyndall. Making a place where the scientist was authoritative had to go hand in hand with making science authoritative (Howard 2004). In June 1859, Tyndall gave a lecture at the Royal Institution now reckoned to be one of the first in which greenhouse gases and their effects were identified—it plays a vital role in histories of climate science (Hulme 2009*a*). That was not, of course, how Tyndall understood what he was doing. He and his allies devoted strenuous labor to the transformation of the peaks into places where reliable knowledge could be made. The security of that knowledge depended directly on these scientists' judgments as to whether these transformations should count as fatal category mistakes or as revelatory clues to matters of fact. They focused on the polemical enterprises that defined what might count as pollution and what as pristine.

A relentless mountain scientist from 1856, Tyndall presented himself as a better experimenter on the mountains than any of his competitors because he was, like Humboldt, superior at risky climbing, more capable at managing instruments, and more adept at dealing with support staff. The treatment of assistants, guides, and mountain dwellers was part of this new science (Hevly 1996; Reidy 2010). Auguste Balmat, a superlative alpine guide, worked for most British scientists in these years and was praised by some because he "became familiar with the nice precautions requisite in conducting the most accurate measurements and received instructions which rendered him perfectly competent to continue by himself the simpler kind of measurements" and because "those who may look with suspicion upon observations made in a remote place by a peasant of the better class will have their doubts removed by data of quite another kind over which the observer could have no control, the Meteorological Registers of Geneva and St Bernard" (Forbes 1846:181–182).

Tyndall's bestselling *Glaciers of the Alps* argued for a novel theory that glaciers move because of melting and refreezing under pressure. It was first and foremost an expository work. It made his name, and it made his specialist science stick. He was writing the book at the same time as he was working on climate change and greenhouse gases, because they were very closely linked topics. He brought the Alps to Mayfair. In 1857, he showed his Royal Institution audiences models of glaciers, ice packed into boxwood molds, and lenses that focused sunlight to melt points far inside ice blocks to illustrate his favored process of regelation. His pictures of "flowers of ice" drew huge attention (Tyndall 1860:354–357). He was left with a puzzle in spring 1859: how did the Earth's atmosphere above the ice fields transmit solar heat? This was why his attention turned to the way a range of gases transmit thermal agency.

Back in London from one of his mountaineering expeditions, Tyndall had to work out how to measure the rate at which different gases would quench the solar heat passing through them. He was measuring minute phenomena: if his campaign was to work, he had to make these phenomena visible to his audience. So he designed a spectrophotometer to show that simple gases such as oxygen and nitrogen did not absorb much infrared (Fleming 1998:68–71). But polyatomic gases like carbon dioxide, methane, and water vapor did. "It is perfectly certain," he decided, that "more than 10 per cent. of the terrestrial radiation from the soil of England is stopped within 10 feet of the surface of the soil" (Tyndall 1872:423). Therefore, "a comparatively slight change in the variable constituents of our atmosphere, by permitting free access of solar heat to the earth and checking the outflow of terrestrial heat towards space, would produce changes of climate as great as those which the discoveries of geology reveal" (Tyndall 1872:4).

The show was carefully orchestrated. He started by showing his audience what a spectrum was and then used a thermopile to detect infrared at the lower end of the spectrum. Once they had become habituated to how this instrument worked, Tyndall got an ox eye to interrupt the light and showed how the infrared was quenched. He set up his spectrophotometer to compare the absorption of heat rays by air with that exerted by coal gas so that its measurements would be visible on a huge screen above him. The result, well rehearsed, was dramatic: carbonic gas quenched more heat than air did. Furthermore, he could show them that the coal gas did not quench the heat of a powerful limelight. The talk ended triumphantly: the differential response of these atmospheric gases explained why planets such as the Earth would be warmer than others (Tyndall 1859).

Crucial, in this impressive show, were two aspects of Tyndall's strategy: his ability to display his experiments as facts and his ability to use everyday phenomena and substances to show that his exotic science mattered in the real world. Neither of these tactics was straightforward. Much of his work was criticized or rejected during the subsequent decades. From germ theory to climate change, the audience was a resource, not a simple target, for public science. Later in the nineteenth

century, mountains increasingly became sites of scientific colonization. This double movement of reality and removal was institutionalized. Savants withdrew to the mountaintops to know the world without parasitic earthly confusion, but at the same time very considerable earthly resources were needed to get up to the peaks and stay there (Callon, Lascoumes, and Barthe 2001:65–67).

Typical of such entangled and polemical projects of climatic transport was work inaugurated at the remote weather station atop Ben Nevis, where the physicist C. T. R. Wilson learned in autumn 1894 about the cloud dynamics he might then mimic with laboratory machines at ground level. Galison and Assmus (1989:232–252) indicate compellingly how the different regimes of university physics laboratory and high-level meteorological station prompted Wilson to design experiments with cloud chambers that could match atmospheric condensation and ionization. These workplaces were social institutions whose success at mixing categories relied both on their networks' integrity and their boundaries' security. Mountaintop scientists constructed workshops, locations of organized labor, that must also have seemed like watchtowers, remotely solitary sites of vigilant immortality.

This remains both a strength and a challenge for modern mountain sciences. Critics and rivals can always appeal to excessive and disturbing linkage with the outside world, understood as pollution and as bias, to denounce the capacity of such observatories. But of course, without very strong linkages with their milieus, these observatories fail completely. There is, therefore, an entire history to be written of the work of the practitioners of these elevated sciences as anthropologists. There are many vital anthropological programs conducted by the personnel of mountain observatories in engaging the communities that surround them. The labor history of mountain sciences suggests how common such enterprise has been in the long career of the peaks and their inhabitants. It also shows what some of the political and practical stakes of such an enterprise might be. As Douglas Adams might have put it, anthropological reorientation of such an enterprise would allow an escape from the facile choice on offer between the distressing roles of electric monk and conspiracy theorist.

Commentaries

Collecting the Proxies and Mementos of Climate Histories

Michael Bravo

In dominant climate narratives today, Arctic peoples function as witnesses to changing weather and as proxies of what might be visited on the rest of the world, experiencing it sooner and amplified. Inuit are among the most visible of indigenous societies in climate-change politics. In that respect, two features of international Arctic governance are worth keeping in mind. First, the Arctic Council recognizes six transnational indigenous "permanent participant" groups as nonvoting representatives alongside the eight member states. Second, the Arctic Council gives considerable policy prominence to the environmental sciences through its six working groups, which produce scientifically informed studies, assessments, and reports with policy relevance. Since its inception in 1996, the Arctic Council has accorded recognition to the importance of Arctic peoples' traditional knowledge in a wide range of policy domains, including its Offshore Oil and Gas Guidelines (http://www.pame.is/offshore-oil-and-gas). For Arctic peoples, hydrocarbons and other minerals are now central to the opportunities afforded by high global commodity prices. What policy and market analysts have begun to call the "accessible Arctic" or the "high North" is now part of "the ice as argument."

Most Arctic peoples would readily agree with Schaffer's observation that scientific authority has long experienced difficulties in carrying public assent. Since the arrival of whalers on the shores of Spitsbergen in the sixteenth century, cyclical peaks in commodity prices have driven the production of sciences allied with resource extraction as well as those linked to state regulation and conservation. One can look back to the Moravian mission's experimental gardens in Greenland during the 1730s, which were intended to demonstrate to Inuit how a small community could sustain itself through disciplined work. The crops grew, but they failed to ripen. Although these initiatives were met by Greenlanders with skepticism, subsequent scientific interventions would be more difficult to ignore. Schaffer correctly notes that it requires both amnesia and nostalgia to consider the history of colonial science projects and see the fruit of a golden age of public trust.

From Barrow, Alaska, to Thule, Greenland, the mobilization of global audiences to secure warrant for claims about the Arctic climate has been critically shaped by a handful of field sites with long histories of state-funded research. Hastrup and Schaffer rightly exhort anthropologists to do more fieldwork at esoteric observatories at high elevations and latitudes, while also recognizing that these observatories are themselves rich repositories of past anthropological study. The Arctic challenge is to understand how *sila* impresses its forces and character on the local judgments of experts who are subsequently made to speak with facticity on behalf of planetary nature.

The Qaanaaq/Thule historical complex of sites, Hastrup observes, has for more than a century hosted the summer migration of visiting scientists to Greenland. Qaanaaq's status as a colonial observatory is historically overdetermined by state policies. Northern Greenland has sometimes been described as a colonial periphery within Greenland itself. It re-

mains subject to the foreign affairs policies of the Danish state and to its geopolitical NATO commitments. Already shrouded by images of "isolation," Qaanaaq was a perfect liminal site at which to situate Thule as a romantic myth about European origins. As the staging post for Knud Rasmussen's fifth Thule expeditions (1921–1924), Thule also became emblematic as the home base for an expedition that set out to demonstrate the unity of the Inuit world from Greenland to Alaska. In tackling such a layered set of time and space factors, Hastrup recognizes the need to decode multiple ontologies implicit in the ice as argument.

Today, northern Greenland produces many of the key photographic proxies for icebergs calving from glaciers. Both photographs and icebergs enter complex systems of global circulation. The elusiveness of place experienced by Aqqaluk Lynge as he remembers the sudden shattering of an iceberg and his escape to safety evokes many other personal histories of Arctic climate. On Hastrup's reading, it is a "memento," in the sense that it is bewildering, elusive, and wondrous, offering a momentary glimpse of the power of *sila*, whose own character is never fully revealed. In Hastrup's exegesis of the ice as argument, she hears *sila*'s polyvocal "refrains" as a means of holding in tension the multiple expressions of its ontological character, together with its discursive and political meanings. Thus, she comes to grips with science as a way of reading ice ontologies. We can go one step farther by situating mementos within the early modern traditions of natural history and collecting. For eighteenth-century naturalists, mementos bore testimony to personal experiences with natural wonders and curiosities, and they were as well markers of learning and distinction. The idea that mementos should be not just remembered but collected, ordered, and classified is key to the legacy of cultures of curiosity: Tupaia's famous chart (c. 1770), drawn at Cook's request, or the chart drawn for Parry by Iligliuk in 1822.[3] These scientifically minded naval explorers prized these extraordinary charts as personal mementos of their Enlightenment ideals as well as proxies for navigation tools. Here, Schaffer invites us to probe more deeply what proxies and mementos tell us about how reciprocal obligations define different modes of indebtedness in exchanges around research sites like observatories.

Throughout the history of science, the debts of scientific travelers to local informants have been the rule rather than the exception. We should examine how, when, and where these debts are acknowledged as mementos or asides—often fleeting sentimental gestures toward what is not said, particularly in spaces of polite conversation, private reflection, and memoirs. Jean de Charpentier (1786–1855) and Louis Agassiz (1807–1873) each recalled with fondness how they had first heard villagers of the Alps telling stories about the glaciers moving (Dettelbach 1996). Hastrup reminds us that Hinrich Rink (1819–1893) similarly inflected his explanation of glacier action by making reference to Inuit explanations (Rink 1974 [1877]). But beyond that, "ice as argument" meant Rink using print culture to try to help rejuvenate the oral traditions of West Greenland, which were, he believed, diminished under colonial rule. Agassiz, on the other hand, built his early scientific reputation on a capacity to identify many new species of fossil fishes by observing subtle differences in detail between specimens that less careful observers overlooked. His romantic, Protestant belief in the unity of nature, together with his obsession with classification, led him to hold strident views on race and polygenesis.

3. Online reproduction of the latter chart can be found at the Web site of the Archive of Early American Images, Brown University: http://library24.library.cornell.edu:8280/luna/servlet/detail/JCB~1~1~4058~6400004:Eskimaux-Chart--No--1-Drawn-by-Ilig.

Snow-Mountains on the Tibetan Plateau: Powerful Proxies across Different Modalities of Climate Knowledge

Hildegard Diemberger and Hans-F. Graf

The honor of the snow-mountains is the snow (song from the Everest region).

Mountains—especially their snows and glaciers—have had a long-standing link with climate science and have acted as powerful proxies not only within a technical discourse among scientists but also for wider, culture-specific messages concerning human engagement with the environment (see also Orlove, Wiegandt, and Luckman 2008). This is clearly shown by Schaffer, who also advocates that a closer look be given at how these dimensions interlink. From Hastrup's long experience of fieldwork in Greenland, we learn how ice has worked as a powerful argument across different modalities of climate knowledge in the Arctic. Both views can provide very rich food for thought in other contexts, such as Tibet, with its Himalayan and trans-Himalayan peaks, where snow-mountains have often been used to make statements about the well-being and the future of the environment (from local narratives to international reports).

We have worked in central Tibet over the past two decades in different capacities: one as a meteorologist working with proxy data from glaciers, meteorological phenomena, and vegetation that help to model the Tibetan microclimate in the framework of cooperation between European and Chinese institutions; the other as an anthropologist working with Tibetan herders on their knowledge about the environment. Brought together by the present network, we have discovered remarkable common ground for a fruitful cross-disciplinary dialogue (see Diemberger, forthcoming). Together we have started to explore the interface between local ways of anticipating the environment's behavior and scientific models used to make projections about weather and climate. We have discussed the usefulness and limits of climate models and what

can be gained from records and observations of people who have been living in this environment for centuries, who have historically experienced varying climatic conditions (e.g., the fourteenth-century megadroughts; see Sinha et al. 2010), and who currently increasingly refer to "climate change" (*namshi gyurba* in Tibetan).

Hans-F. Graf, working in the Namtso area of the Tibet Autonomous Region, has explored the mechanism by which rain and snow tend to concentrate on mountains (see CA+ online supplement A[4]), with the relevant cloud formations potentially interacting with the moisture coming with the monsoon and inducing precipitation, thereby linking local and regional weather systems. He has also observed that cloud formation and precipitation in the Tibetan environment are poorly captured in larger climate models and may be significantly affected by dew, which produces small but significant clouds and is linked to vegetation cover. The local and regional moisture circulation systems are thus vulnerable to land-use changes—especially overgrazing (Cui et al. 2006; Graf et al. 2011). Issues of global climate change are therefore necessarily entwined with local and regional anthropogenic variations.

Hildegard Diemberger, working mainly in the Porong and Dingri areas of the Tibet Autonomous Region, has explored the role of mountains in local understandings of the landscape, observing that the impact of grazing animals on the pastureland is determined not only by numbers but also, and more significantly, by mobility and flexibility (see figs. B1–B3, available online). Taking into account Graf's observations, the detrimental consequences of mobility loss (clearly shown by Sneath [1998] in the case of Mongolian herders [see also Sneath's images, figs. B4–B6, available online) are likely to affect not only the rangeland but also the local and regional climate. In a system of beliefs that links landscape, weather, and livelihood, rules concerning the movements of herds, reflected in ancient documents or current practices, can have both an ecological and a moral dimension linked to what is considered the best possible human interaction with the environment and to the long-term goals of a community. Mountains, with their snow cover and cloud formations that potentially interact with the monsoon system, are therefore not only central elements in the scientific analysis of local and global climate but also "lords of the land" (*sadag, shibdag* in Tibetan) who control the weather and the prosperity of their territory. Like the glaciers described by Cruikshank (2007:366), mountains are attributed characteristics rather different from those discovered through science. In both settings, these have been a sort of environmental "proxy" for local communities for many centuries (see figs. B7–B10, available online).

4. The slides in the supplement are a representation of local moisture circulation as observed in the Namtso (Nam Co) area, following a pattern that can be found all over Tibet. The computer modeling of convections and clouds is work in progress and is based on the PhD research of Thomas Foken (supervised by Hans-F. Graf). This is part of the wider interdisciplinary project "Tibetan Plateau: Formation-Climate-Ecosystems"; see http://www.tip.uni-tuebingen.de/index.php.

Sacred mountains that have traditionally been used as indicators of the well-being of a certain area not only are elements of a specific "moral climate" (Huber and Pedersen 1997) but also can reflect the state of the relevant microclimate and its interface with the monsoon systems. Embedded in moral, religious, and even political narratives, observations of snow-mountains can make climatological sense and be relevant across knowledge regimes. They can produce a host of interrelated arguments that link mountain ice and snow to clouds, rain, dew, grass, springs and lakes, animals and all kinds of features of the environment, and ultimately human behavior. At the same time, scientific weather data and climate models are embedded in the social and political context that produces climate science and its multifarious applications. This leaves us with some open questions: Is there a way out of the opposition between essentialized notions of traditional local knowledge (either doomed as backward or romanticized as indigenous wisdom) and modern universal scientific knowledge? If this is the case, how do we move from dialogue to cross-fertilization without collapsing one form of knowledge onto the other? Beyond academic and policy debates (see, e.g., Magistro and Roncoli 2001), these issues have an immediate practical relevance.

Deteriorating environmental features, interpreted as indicators of impending irrecoverable natural disaster, have often been at the center of a blame game between rural communities and state administrations as to whether local herding and agricultural practices or the rapidly expanding industrial and urban development are responsible for what people are experiencing. Many decisions that are currently made on a day-to-day basis at state, regional, and grassroots levels concern the destiny of many people who need to adapt to changing environmental conditions: from changes in land management to relocation (see Harris 2010; Yeh 2005). The decision-making process itself is thus as important as the knowledge that informs it. People who determine the course of action may address unprecedented challenges, but they envisage the future with reference to their recent and ancient past (in terms of continuity or discontinuity). They often navigate different knowledge regimes and act according to their constraints and aspirations. Questions concerning the epistemic and social authority of the conceptual models that inform their actions (see Hulme 2009*b*) are therefore pressing; decisions in which different modalities of climate knowledge can be integrated, disregarded, or remain opposed are likely to result in very different social, political, and environmental outcomes.

In the market stalls near the main temple in Lhasa, a new object has recently appeared: a solar powered prayer wheel (see fig. B11, available online). Joining a host of similar Tibetan merit-making objects powered by water, wind, heat, or human hands, it reminds us of the power of Buddhist—and now "green"—aspirations. Made of plastic or metal alloy in a factory in China, where massive efforts to develop renewable energy sources go hand in hand with soaring emissions from the expanding industry, it reminds us of the gap between

aspirations and the messiness of real life—and recalls the electric monks delegated to believe for us.

The "Milkbird" as Proxy: Anthropology Meets Biology on the Tibetan Plateau

Jacqueline Hobbs and Jason Davis

Kirsten Hastrup writes on the modalities of climate knowledge and the multiple climate histories that both "planetary science" and "local observation" produce. Simon Schaffer suggests that social anthropology could conduct a history of nineteenth-century proxies for mountain peaks that made both mountain science and its scientists authoritative. We believe that it is in developing a "transdisciplinary" approach to the study of environmental change that social anthropology can most valuably engage, rooted in the "shared language" that grows out of genuine interdisciplinary collaboration. This statement originates in joint research conducted among the Chu khol ka nomads on the Tibetan plateau in 2008. Jacqueline Hobbs (a social anthropologist) was researching Amdo-Tibetan constructions of time. Jason Davis (a biologist) was mapping the impact of human environmental disturbance on the stress and reproductive neuroendocrinology of songbirds. Common to both their work was what the Chu khol ka nomads call the "milkbird."

The Chu khol ka nomads (see figs. B12–B17, available online) of the Amdo-Tibetan Golog region in today's Qinghai province (People's Republic of China) use the milkbird (*jo byebu* in Amdo) as a proxy by which to establish authority in the face of uncertainty. Such authority emerges as part of a narrative of unity linked to Tibetan Buddhist cosmology and the Tibetan calendar (*lo tho* in Tibetan). This narrative is an aspirational vision creating coherence among heterogeneous contradiction: a unitary "discourse" of both hegemony and contention. Consequentially, as a proxy, the milkbird anticipates global uncertainty and even the "change of the universe" mentioned by Hastrup.

The milkbird comes in summer between the fifth and mid-seventh Chinese lunar months. For the Chu khol ka nomads, the appearance of this small bird heralds the time when their female yak begin to give milk. This seasonal event is linked with the grass: when it grows, the yak are well nourished and their newborn calves are healthy. But with radical environmental change over the past 50 years, today the grass hardly grows over the nomads' shoes where once it was waist height. The baby yak are weak and often do not survive: in some years, the mothers do not even become pregnant. Correspondingly, the Chu khol ka nomads say that the milkbird is disappearing—even that it does not come anymore.

The notion of a proxy is not new in the sciences but has been little explored in the social sciences. Tibetans often twine observation of their natural environment with indicators regulated and anticipated by proxies, such as mountains, birds, animals, and landforms, yet show an awareness of variability. For the Chu khol ka nomads, the milkbird figuratively represents an understanding of the natural environment across different systems and modes of communication. It expresses Amdo-Tibetans' anxiety about the future: a symbol of their deteriorating natural environment linked to pastoral migration cycles, the gestation cycle of the yak, a "grass calendar," and the observation of nature linked to time. Specifically, the milkbird is a proxy for the stable/permanent versus changing environmental conditions of the Tibetan Plateau, where the Chu khol ka nomads are projecting the well-being of natural systems onto a bird. Further, the milkbird is a proxy for the increasingly erratic appearance of their whole world. With "climate change" defined as a political and natural threat to traditional lifestyles, aspiration and reality diverge to the extent that such proxies are no longer working. For the Chu khol ka nomads, the disappearance of the milkbird symbolizes the end of certainty, the moral decline of Amdo-Tibetans, and the possible extinction of humanity itself.

Amdo-Tibetans use proxies, then: proxies that may also be used by those studying them. What came to light during our collaboration is that both of us were using the milkbird ourselves to establish the authority of our own singular disciplines. In fact, the local informant, the physical scientist, the social anthropologist, the politician, and Amdo-Tibetan nomads chronicling environmental change are all brought together within the Tibetan Buddhist moral universe of the milkbird. An "assemblage" (just as Hastrup defines one) of multiple histories of weather, climate, people, and places, the milkbird is something of an enigma, since Amdo-Tibetan accounts of its appearance often contradict, making conclusive identification impossible. The milkbird is both elusive and solid, then, and so are the "grand stories" of planetary science and local observation interacting with it.

Specifically, the milkbird spells out, to physical scientists analyzing it, the importance of local observation that tests and corrects climate models projected on the basis of the scientific method and established debates of "climate change." This is because local observation provides an immediate ground-level account and a time depth of knowledge of changes on the Tibetan Plateau over the past 50–100 years. But it also highlights exactly where to question the reliability of local observation and where other reasons for Amdo-Tibetan statements—again linked to "climate change"—must be found. Similarly, the social anthropologist can identify the points of congruency and conflict between local observation and multiple types of cultural knowledge: conclusions about which must *additionally* be underpinned by hard scientific data.

The milkbird case also highlighted for us the highs and lows of interdisciplinary engagement. Davis asked Hobbs to interpret his data and interview the Chu khol ka nomads about changes in bird sightings over the past three generations. Hobbs became aware of how the Chu khol ka nomads were using the milkbird as a proxy linked to the calibration of the Tibetan calendar.

Meanwhile, Davis began to question the reliability of his data and was able to interpret curious anomalies. We even discussed writing joint research pieces on "climate change" for the public and media. However, in large areas biology and social anthropology simply could not "speak" to each other. Their theoretical starting points and core assumptions were very different. We also had problems understanding each other's technical terms. The challenge seemed to be making each discipline practically applicable to the other in an ongoing and embedded way. For example, Davis ultimately concluded that local observation was not reliable enough for inclusion within the scientific method. Once he understood how to design interview questions himself, social sciences research methodology became somewhat redundant.

There are several issues here that converge on the multiple spaces where seemingly conflicting knowledges and methodologies come together and we ask which to consult when. Most of all, our interdisciplinary collaboration led us to seriously question what constitutes authoritative knowledge: something that, interestingly, is not such an issue for Tibetans. The authority of their systems of knowledge is sourced in the Buddha. Contradictory sources of authority pose no serious challenge, since via the narrative of unity of the *lo tho*, authority in conjunction with proxies is rendered continuous—part of an ongoing historical debate between multiple systems of knowledge held by competing centers of power.

Might social anthropology forge such a "narrative of unity" between and across disciplines? Where academic parties share a deep enthusiasm for the subject, a new language naturally develops that can be documented—particularly when the authority of knowledge is contested in collaboration. For us, the respective limits that social anthropology and biology provided for each other saw that "real dialogue about the deeper meanings" that Hastrup mentions come to the fore. Here the differences between disciplines are upheld, simultaneously with a methodological approach that traverses their boundaries. Hacking (1990) likewise challenges us to rethink interdisciplinarity in terms of individuals from different disciplines with overlapping interests: "not a tale of breaking down of disciplinary boundaries, but of mutual respect, which, as a new group of issues arises, may create a new discipline."

The Social Life of Climate Change: Weather Data, Glacial Retreat, and Mountaineering from the Land of Snow to the Rwenzori Mountains

Maria Luisa Nodari and Giorgio Vassena

Simon Schaffer highlights how records, proxies, and accounts concerning mountains have been used to mobilize people, as well as ideas, in relation to changing environmental conditions across different domains and how climate science must be understood within the social context that produces it. Here, we suggest that it is actually possible to speak of a social life of climate change. Our collaboration brought together an engineer/surveyor and a social anthropologist, both mountaineers, who looked at historical and current data collection on weather and glaciers. We observed that such an operation is not only a source of data for climate research at the global level (with ice and snow as a source of some of the most important proxy data connecting peaks across the world, the Arctic, and the Antarctic) but also a cultural operation in its own right within a social network that links scientists with mountaineers, sponsors, and NGOs. The particular network we have been involved with links more than 11 international and local institutions, ranging from Alpine clubs to universities in Uganda and Italy, national parks, NGOs, and private enterprises, as well as people living in mountain environments.

Our particular work has followed the legacy of Prince Luigi Amedeo of Savoy-Aosta, Duke of Abruzzi, who in 1906 climbed Mount Rwenzori in East Africa and left important accounts and photographs that bear witness to the dramatic change of the glacier cover on the top of this mountain (see figs. B18–B21, available online). A few years later, he carried out similar enterprises in the Himalayas, combining mountaineering and exploration with data gathering (de Filippi 1908; Roccati 1909). Some hundred years later, a team of Italian scientists and mountaineers sponsored by the Italian Alpine Club followed in his footsteps while trying to address climate change. The scientists drew on 7 years of glacier-monitoring experience in the Changri Nup Glacier in the Mount Everest area (Smiraglia et al. 2007). In the Rwenzori Mountains, they combined mountaineering and scientific practices such as global positioning system surveys and ablatometric and laser- scanner measures[5] to gauge key glacial changes over time (see figs. B22–B24, available online). Through correlation of weather and glacier data, these scientists are investigating the hypothesis that glacier melting patterns (depending on position, exposure, and cloud coverage) suggest a high probability that an increase in the glacier melting rate is due more to a decrease in cloud coverage than to an increase of air or rock temperature (Mölg, Georges, and Kaser 2003).

Such work can elicit a wide range of interpretations among local people, who generally express their anxiety at the potential loss of ice and snow in their landscape, which would lose its powers. Local people get entangled with scientists and mountaineers in their data-gathering exercise. Perceived changes in the natural environment become the basis for a shared vision even when they rest on ideas about "climate"

5. Glacial mass balance—the difference between accumulation and ablation (melting and sublimation)—is measured by geodetic methods. Three-dimensional laser-scanner techniques collect data that can then be used to construct digital three-dimensional models.

and "change" that are radically different. "Climate change," as an idea and not just a phenomenon, thus generates a social life of its own kind, mobilizing and connecting the very different groups of people we have mentioned. These groups—with different positions of power and different visions—share a fear of climate change and perceive a sense of urgency for the fate of the mountains and a need for quick answers (Club Alpino Italiano 2008). They have started to collaborate with each other in the name of climate change: creating and sponsoring projects to monitor Rwenzori glaciers, collecting data on glacier melting though mountaineering ascents, comparing new data to 1906 data, implementing development projects in the Rwenzori National Park, and producing a documentary on the expedition celebrating the centenary of the scientific and mountaineering mission of the Duke.

Glaciers are considered among the most sensitive indicators of climate change (Seiz and Foppa 2007), but they are also social spaces and sites for human encounters among different people, as suggested by Cruikshank (2005). She observed how those encounters could generate different interpretations of the landscape and also how glaciers are actors with their surroundings. Rwenzori has become a site of encounters between people who have different ways of perceiving its glaciers and who question its ice differently. Scientists search for data; mountaineers hope for the preservation of the integrity of their target; tourists admire tropical ice and snow; local people hope to preserve the integrity of their environment; and institutional representatives attempt to keep power by showing success in water preservation, environmental conservation, and economic development.

While glacier mass balance is measured and questioned, scientists seem to be increasingly asked by mountaineers, local populations, and institutions to act as a kind of diviner, giving quick and certain answers to their urgent sense of threat. The very way in which science works, however, relies on debates over time, as all data have a degree of reliability and the resulting models have a degree of uncertainty (Kaser, Fountain, and Jansson 2003). This creates a complex tension.

"Climate change" also reframes the ancient relationship between mountaineering and science as distinct but interfolding activities, as suggested by Simon Schaffer. The perception of climate change generates social life in the shape of encounters, collaborations, and projects. It generates the need for proxies that can be found in ancient and new data on weather and glaciers. Those data thus have "social biographies" and travel within networks (Appadurai 1986); in our particular case, scientists and mountaineers who came from an Alpine country first engaged in the Himalayan experience and then went to the African mountains. This is one of the many cases in which regions that are geographically far apart are brought together in a sort of new mapping exercise and weather data concerning ice move groups of people along particular itineraries within a global perspective. This new global geography of climate change is nonetheless vulnerable to fragmentation through misunderstandings across disciplinary boundaries, differing scientific cultures, and gaps between specialized knowledge and wider perceptions. In addition, the same weather data reach local communities and are read in a local perspective—but also simultaneously in a global one shaped by world media. Climate change seems, therefore, to connect and disconnect different groups of people and different modalities of climate knowledge; it becomes, as Hastrup suggests, an actor in a "human-nonhuman network."

Greenlands and Waterlands: Digging into Climate History in the East Anglian Fenlands

Richard Irvine and Christopher Evans

Kirsten Hastrup asks us to hear the ice as a refrain. In her account, ice is not merely a background to life but is also an agent—human survival, understanding, and self-expression are shaped through and around relations with it. She also provides a vivid historical portrait of the process by which scientific knowledge is set apart from "local" knowledge, creating a multiplicity of climate histories emerging within and around the "figure" of the ice. Here, we respond from our respective perspectives as an archaeologist (Evans) and an anthropologist (Irvine) sharing interests in the socioenvironmental history of England's East Anglian Fenlands. Subject to long-term marine flooding and a resultant backup of its watershed river systems and lying within the immediate hinterland of the University of Cambridge, this great marshland basin—both its prehistory and its environment—has certainly been much studied (e.g., Evans and Hodder 2006*a*, 2006*b*; Godwin 1978; Hall and Coles 1994; Waller 1994; see also Smith 1997, for a history of Fenland research, and figs. B25, B26, available online).

In terms of abiding landscape dominance, Hastrup's ice "atmospheres" resonate with the role of water in the Fens. That said, her evocation of ice as an all-embracing constant sits somewhat uncomfortably with the degree of environmental change and cultural adaptation that the Arctic has experienced over the past millennium (e.g., Hoffecker 2005), which is not unlike the recent evidence from the Amazon's rain forest concerning the scale and monumentality of its settlement systems and their accompanying clearance/horticulture at and before colonial contact (e.g., Heckenberger 2005). The Fenlands therefore provide a useful ground for further examination of this theme, as it is precisely through landscape change that the environment comes to be understood.

The changing environment acts as an agent, and it is an agent into which people—farmers, turfmen, ditch-diggers, or archaeologists—dig. We suggest that through these acts of

digging, different climate histories are made visible, and following from Hastrup's awareness of how different stories about the environment might interact or become disconnected, we briefly remark on how local knowledge of environmental archaeology is integral to the process of researching the climate history of the Fenlands. In short, different acts of digging into climate history overlap and inform one another. It is here that our archaeological and anthropological perspectives fruitfully intersect—cultural knowledge is grounded in environmental archaeology, and environmental archaeology is read through the lens of a set of cultural representations of the landscape. In such a context, interdisciplinary dialogue becomes essential.

As the peat soil of the Fenlands is plowed and worn away, preserved oaks are exposed, the remains of a woodland submerged by rising sea levels at the end of the last glacial period (Evans and Hodder 2006*b*). These "bog oaks," or "black oaks" (see fig. B27, available online), are a source of considerable frustration to farmers, as they can wreck machinery, and it takes considerable effort to dig them up, "like pulling teeth," to use the summary of one Holme Fen farmer. These bog oaks were historically valued as fuel (Marshall 1967:114–115).

As Bloom (1944:165), a farmer who reclaimed Burwell and Adventurers Fen for agriculture during the Second World War, has remarked, "There was ample opportunity to form a picture of what had happened perhaps a hundred generations or so ago, when this great forest became extinct"; the literature of Fenland recollections is rich in such accounts (Evans 1997). Growing interest in local studies generated more complicated "lay" modes of environmental explanation before the regional application of scientific paleoenvironmental researches during the second quarter of the past century and, later, radiocarbon dating. Charles Lucas—a Fenland polymath and a drainage commissioner—deduced in 1930 from the shared orientation of fallen fen-fast trees that they must have been blown down in a sudden cataclysm. This, he thought, could have been caused by the rapid subsidence of the fen basin floor occurring simultaneously with a volcanic eruption, a tidal wave, and a hurricane; associated relics indicated that this catastrophe must have taken place in Roman times. Lucas postulated that these events might have related to the climatic disturbances that were unleashed on the world at the time of Christ's death. Yet he then went on to astutely observe that this could not have been the case, for the Crucifixion was known to have occurred in the spring (Easter), whereas the trees recovered from the peats are in full leaf; therefore, this Fenland cataclysm could have only taken place sometime around September in the year of the Passion: a precise, if nonabsolute, chronology (Lucas 1930:7–11, 32–35).

Sybil Marshall offers a detailed account of the stratigraphy of the land from her father, who lived and worked near Ramsey as a turf digger and farmer and also for drainage boards. He describes the topsoil, then the 2–3 feet of peat, digging through to the "buttery clay" and "the peculiar peat known to us as 'bear's muck,' on account of it being so difficult to work. . . . The bear's muck varies in thickness, but there's always a screed of it. . . and it's in this bear's muck as the nuts and acorns lay" (Marshall 1967:113).[6] These nuts and acorns, which Sybil Marshall's father collected, are a tangible reminder of the radical changes that have swept over the landscape: once woodland, then marsh, now arable farm. Bloom (1944:166) and Ennion (1949:45) give accounts of beaver bones being found as ditches were excavated and speculate as to the nature of the gradual change from forest to swamp. In these observations and theorizations we see glimpses of an environmental archaeology, a grounded awareness of and curiosity about the past as labor makes that past visible.

Sometimes this environmental past is an ally. The peat soil, which is a product of river flooding and prolonged waterlogging 8,000 years ago and was preserved in the millennia that followed by periodic inundation, has played a crucial role in the economy of the region. Historically, the cutting and drying of peat for fuel has been a major occupation for men in the fen communities (Hill 1992), while the peat soil itself, once drained, is seen as particularly fertile land for intensive arable farming—although the process of using the land for such a purpose is self-defeating in the long term, as the peat shrinks and wastes away once drained.

At other times, the environmental past is an antagonist, as seen in the struggles with the bog oak. Indeed, Bloom (1944: 145,152–153) tells us that as part of the war effort, Royal Engineer expertise was drawn on to blow the things up so that the land could be used to boost domestic productivity and ensure food security. Those who are witnesses to the struggle with water, having made great effort to maintain drainage of the land, see in the stratigraphy evidence of this struggle with going back into prehistory: "I doubt whether any story could be told beyond that of floods and drier periods alternating all through the centuries down to the time when men began to secure the means to subjugate, and apply those means" (Bloom 1944:167). This reflects earlier narratives offered as part of grand-scale engineering projects in which the prehistoric fens are seen as something to be subdued through work (e.g., Dugdale 1662; Elbstobb 1793).

Our co-commentators respond in a somewhat literal way to Schaffer's account of the production of proxies by producing proxies of their own. Here too, bog-oak chronology can be seen as a proxy, the use of which is currently being investigated by geoarchaeologists, climatologists, and others (see, e.g., Sass-Klaassen and Hanraets 2006; Swindles and Plunkett 2010). But when these oaks are encountered in the landscape, they are more than this; they are tangible impositions of past climate in present life. They are part of a refrain telling of a watery past.

The nature of the contemporary landscape is a product of

6. Evans has heard it explained during excavations that the name "bear's muck" relates to the striking smell of this well-preserved deposit. In his experience, it is rather soft and easily dug.

environmental change and human labor. The surface appearance of that land, however, obscures this history, creating a visible appearance of agricultural order. Water is something to be managed, something that is pumped away from the land by pumping engines and carried along man-made waterways. But different histories of the interaction between water and land become visible as communities dig into the landscape. Environmental archaeology allows us to understand that the Fenland is a product of inundation and of the attempt to manage and exploit inundation—and this archaeology is grounded in a knowledge that is not simply the domain of professional archaeologists. In becoming aware of past inundations below the pristine surface, we see the places where there was once water and, given peat shrinkage, isostatic rebound, and rising sea levels, where there may in the future be water again. The sound of this watery refrain can be heard in a song by Norfolk farmer Fred Rooke, born in 1935:

> There are farmers a-living in the fens
> Which once was the floor of the sea
> And it might very well be sea again
> If the water in the dyke get free.
> So beware of the hour that the captive power
> Of the water in the dyke get free.

Short Comments

Marilyn Strathern

Anthropologists are generally—and these essays offer exquisite evidence that they are—alert to the nontranslatability of different types of knowledge across conceptual universes while continuing to communicate that very sense of difference. But these accounts also nudge us in a further direction. Logically, it is impossible to have different perspectives on the same problem, for each perspective creates its own problematic—the question, then, is how "one problem" (climate change) emerges.

For Hastrup, ice is agent, its own argument, and argues in as many voices as there are people to relay the tale. Importantly, everyone wants to tell a tale about the ice. In his spoken version, Schaffer noted how geographers constructed different mountainous places as a single species. So mountains appear as versions of—to be compared with—one another. Perhaps we might borrow from another kind of perspectivism (namely, Amazonian perspectivism) a glimpse into these writers' apprehension of a world that is also many worlds and where oneness rests in the human endeavor of being and understanding. In this truth, there is a multiplicity (at once infinite and interrelated) of climate problems and an extraordinarily uniform consensus that change is afoot.

Taking a lead from these two accounts, then, we might want to listen again to the stories of diversity, of unique microclimates (Diemberger and Graf), attempts to replicate observations (Nodari), assemblages (Hobbs), distinctive histories (Irvine and Evans), and mementos ordered and classified (Bravo). And we would be listening against an unstill background of flat, silent/rearing, crashing ice.

Mike Hulme

It is harder than one might think to discover where climate change is happening. If it is "out there," then we have problems of access: What places, instruments or models can reveal climate change to us? If it is "in here," then we have problems of persuasion: What chains of reference will adequately connect my convictions with yours? Both Simon Schaffer and Kirsten Hastrup draw our attention to some of the frustrating difficulties that emerge when we think deeply about climate change: for example, the authorization and mobilization of placebound scientific knowledge or the inadequacy of the categories we impose on our lifeworlds to try to make sense of them.

Earth-system scientists have tried heroically to make the task of discovery simple for us: an index of global temperature, satellite images of pulsating Arctic sea ice, a computer-simulated climate of deepening yellows and reds. But this effort has proved *too* simple. These artifacts of science are too abstract, too remote, too febrile to overwhelm us. We resist with (perhaps) good reason. Cultural artists try different strategies. Rather than simplifying complexity, they seek to communicate ambiguity, often through the malleability of materials such as ice. By being suggestive, they seek to release the human imagination, encouraging each of us to make our own connections. But here, too, we are insufficiently overwhelmed. As Hastrup argues, there is danger in subverting ice to do our work for us.

We need a bigger story about climate change—about our appropriation of climate as a human prosthetic—than can be offered by science or art alone. It is a human story about no less than the entirety of the past and of the future, and it is a story that must transcend our human categories. It can only be invented, yet it must be enacted. It is going to require some leap of faith.

Georg Kaser

Since a change in climate cannot be repeated at any time, like experiments in a lab, rules other than those of pure physics have to be applied to perform reliable research. Observations of changes, the identification of drivers, process studies, and the search for similar situations in the past are identified as

a useful set of tools. If carefully applied and iterated against each other, they lead to high confidence in the resulting understanding of the climate system and its changes. The look into the past is one essential tool that can testify as to whether the present changes are exceptional. Yet the earliest measurements started only in the mid-nineteenth century, and reconstructions based on the observations of approximate climate indicators—proxies—are essential. These proxies are of different kinds, their links to climate drivers are complex, and each proxy tells just part of the climate story. Only a few proxies are of a purely physical nature; the great majority involve chemical and even biochemical processes. The retrieval of related climate signals is never straightforward, and only the combination of a series of proxies gives confidence in a reconstructed climate history. Can sociohistorical narratives add good value to the incomplete picture we have about past climates?

Simon Schaffer and several of the ethnographic commentators show that certain natural features, for example, in mountainous environments, can work as proxies not only in a scientific discourse but also in the relationship between scientists and the wider public, as well as that between scientists and policy makers. Kirsten Hastrup explores how ice is deployed within different forms of climate knowledge in the Arctic. Both the lead articles and the ethnographic commentaries point to a basic questions: Can different forms of knowledge, including some that so far have been little considered in climate science, contribute to our understanding of past and future climates? If so, how can they be used? These so-far-unused proxies may become precious bits to be added to the puzzle of climate reconstruction provided that rules can be developed on how to interpret them. These rules have to be jointly developed by both the social and the physical scientists involved.

Barbara Bodenhorn

Hastrup and Schaffer are exemplary in their invitation to consider disciplinary perspectives as the source of particular points of view that may nonetheless engage with others. With Hastrup we hear the refrain of ice—the resounding crack of an ice-calving event producing its own terrain, its own space/time. With Schaffer we see the mountain as the site of data gathering, as the watchtower, as a climate-knowledge proxy. In both accounts we are invited to recognize nineteenth-century moments as productive through knowledge sharing: Arctic science that relied on rather than separated itself from the knowledge of Inuit hunters; Tyndall's skill in displaying his knowledge to the Royal Institution as "facts" made intelligible by the speaker's ability to connect them to the interests and concerns of his nonspecialist audience. Resonating with Bravo's commentary, I would note the extent to which twenty-first-century indigenous peoples are themselves engaging with scientists and not simply responding to them as research subjects—often in response to conditions emerging through climate shifts. In Canada, glacial melt has "produced" human remains; in Alaska, coastal erosion has done the same. In both cases, archaeologists have been contracted by local residents to help them understand more about their own pasts. What and who might be understood as a proxy (for what) is ambiguous. Here I would sound a caveat. The Arctic may indeed provide an environmental proxy; it is trickier to invoke Inuit in the same way. Irvine and Evans note the limits of the category, warning us not to reduce the richness of the cultural record to this powerful descriptor. In the boardroom, rather than on the tundra, proxies come to stand *for* an absent presence. Anthropologists need, perhaps, to be careful not to reduce the power of proxy as a form of analytical shorthand to another form of representation—it will be a great temptation. Sometimes the ice is indeed its own argument.

Response: Hastrup

Kirsten Hastrup

What strikes me in the above series of thoughtful reflections on climate histories is the shared will to look beyond one's own particular scholarly field when dealing with climate histories. This reflects an increasing awareness of the emergent nature of "climate," always responding to the tide of times and by default conflating different kinds and scales of knowledge. It was only in the twentieth century that "climate" moved out of geography and into physics and thus shifted from being directly observable and experiential to being an issue of atmospheric conditions, best grasped in large-scale models and statistics (Heymann 2010). Gradually, this process has come full circle, once again grounding climate knowledge in solid earth and in social life, the Anthropocene having replaced the Holocene as the name of the present geological era. Technological and social advancement has come to a point where it is no longer possible to understand the Earth as independent of human influence, hence the Anthropocene (Ehkers and Kraft 2006). After more than 10,000–12,000 years of agricultural development, on top of which we have seen some 200 years of intense industrialization, exponential global population growth, and massive urbanization, the human fingerprint is everywhere, on the land surface, in the oceans, in the atmosphere. The earth is so deeply marked by human activity that climate cannot be understood without acknowledging this. In that sense, we are at "nature's end" (Sörlin and Warde 2009). This provides scholarship with an inducement to rethink foundational dualisms, as reflected in the individual statements above.

Schaffer reminds us of Alexander von Humboldt's aspirations on behalf of a global science of climatology that would

incorporate rather that alienate geography and experience, and Bravo in his discussion highlights the entanglement of multiple ontologies in the understanding of place. Whether we reach "climate" from the natural or the cultural perspective, it refutes any facile classification and draws our attention to something far beyond our starting point. Not surprisingly, perhaps, this transpires most clearly from studies in high mountains or high latitudes, where mountaineers and scientists have for a long time met with locals for whom the challenges of ice and snow were to be met on a daily basis. As Nodari and Vassena write, in the process mountains have become proxies for climate and thus have contributed to the formation of the very idea of "climate change."

In their comment, Hobbs and Davis point to a biological proxy of climate change in Tibet, namely, the milkbird, whose erratic behavior these days is read as the end of certainty. While from a biological point of view the bird's behavior may not seem uniform, let alone decisive, from an anthropological perspective its authority remains. The challenge, of course, is to unpack "authority" and enter into a productive dialogue between sciences without their either canceling each other out or simply collapsing into one. This issue is raised by Diemberger and Graf on the basis of their distinct scientific approaches to environmental change in the Tibetan highlands, and they suggest that the choice of which knowledge to act on is as much matter of local constraints and aspirations as it is a matter of attributing absolute authority to one kind of knowledge over another. Along similar lines, Irvine and Evans dig into the Fenlands and make a strong case for archaeological and anthropological collaboration in the establishment of climate histories. This particular case testifies vividly to the watery refrain implicit in the long-term history of living with or in the Fens as well as to the attempt at disconnecting the future of the Fens from the past through the engineering work by which particular social aspirations were articulated.

This leads to the last short comments. Strathern points out that it is logically impossible to hold two different perspectives on the same problem at the same time, and Hulme makes a corresponding (if different) claim that the story of climate must transcend our human categories. Kaser calls for rules to be jointly developed by physical and social scientists for both parties to be able to use the rich proxy sources in a manner that pays heed to their actual significance. While such rules may be difficult to achieve, given the complexity of the climate issues in both fields, the plea resonates with Bodenhorn's well-taken warning (echoing Irvine and Evans) not to reduce proxies to simple indicators or descriptors of climate change.

Returning to the remarkable will to transcend the boundaries of particular scientific fields, it seems that "climate history" is a fortuitous site for establishing a combined understanding well beyond the obsolete dualism of nature and society.

Response: Schaffer

Simon Schaffer

In their remarks on our local Fenland cultures and climates, Irvine and Evans point out that woodland remains, underwater at the last glacial period then revealed when peat soils erode, can become proxies, indicators of past climate. But bog oaks are always much more: a source of fuel, damage, and the variable insistence of older climates. Fascination with proxies, as technical terms and cultural artifacts, lies partly in this double movement of limitation and expansion. Experts limit meanings and uses, teasing signals from other properties judged noise: this is how objects become viable proxies. Yet the interests of climate histories in their most expansive sense must attend to the worlds in which such entities trouble or comfort us. Hobbs and Davis indicate how the milkbird of the Tibetan Plateau is an agent both in authoritative knowledges and in enterprises where knowledges do not agree. Diemberger and Graf hold that great Tibetan mountains, "lords of the land," work as usable signs in knowledge systems simultaneously comprehensible within scientific models. The commentaries gathered here explore this pervasive dilemma of definition and delimitation.

There has long been a suggestive relation in European public culture between proxies' definition and the careers of icy climates. Hobbs and Davies observe that the term is scientifically familiar but neglected in the social sciences. Yet it originated as a social concept, an authorized deputy or the act of choosing on someone else's behalf, before being extended from persons to other things. In mid-Victorian London, where atmospheric gases began to be associated with global warming, panorama managers touted what they started to call "traveling by proxy," from Leicester Square to the Arctic in the wake of the absent Sir John Franklin. Images of "towering ice bergs of gigantic size and the most fantastic shapes, threatening each moment as they are driven in mighty strife," were displayed alongside "an Esquimaux dress and other minor matters of attraction" (Burford and Selous 1850:3). As both Hastrup and Hulme indicate here, metropolitan Europeans thus have significant traditions of subverting ice as proxy to do their work.

Hastrup also reports the telling view of a seasoned Greenland hunter that the work of obtaining ice cores, initially pursued in the 1960s in U.S. Arctic military bases, is a cause of climate change, of which air trapped in the cores has been taken as proxy. My sole experience of such subversion was last year in South Kensington, under blue light, behind glass. In preparation for *atmosphere*, an ambitious new exhibition on climate science, an Antarctic ice core that was obtained in 1989 on the Dyer Plateau and carried to a research station on Adelaide Island and then to the headquarters of the British Antarctic Survey in Cambridge was put into a medical freezer in the Science Museum. It is there because the core allegedly

has an aura that works on those who need to be mobilized around the causes of climate change. All the mediations on which its job as proxy depends must somehow vanish in a culture that privileges immediate voice.

This is why this collection of comments and stories addresses the puzzles of scale and mediation. Climate histories hinge on uncanny switches between vast and tiny, remote and intimate, global and local. Bravo reminds us that the power of *sila* over experts' "local judgments" makes them accounts of "planetary nature." This is never a simple contrast between small-scale culture and global sciences. The proposal is to trace how entangled locales interact, interfere, drift. In their study of Saami cultures in northern Finland, Ingold and Kurttila (2000) examined how ranges of local knowledges are different not in epistemic status but in the practices that make them. Perhaps the most familiar version of this approach lies in the many attempts jokily or seriously to juxtapose weather and climate: "climate lasts all the time and weather only a few days." For Ingold and Kurttila, "climate is recorded, weather experienced" (Ingold and Kurttila 2000:187). The significant point here has already been made in Cruikshank's (2005:250) remarkable account of glaciers, voice, and culture: "climate science presents a more comprehensive picture than weather," yet at the same time "oral traditions convey understandings that are much broader than data." The challenge is to mobilize these insights about broad comprehension, both as scale and as understanding.

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