J. R. McNeill

AHA Presidential Address
Peak Document and the Future of History

J. R. McNEILL

Some years ago, I had the good fortune to join a small troop of geologists tramping around northeastern Iceland on the trail of a *jökulhlaup*. To find traces of a *jökulhlaup*, you hunt for rounded "erratics." In Iceland, those erratics—boulders that look out of place—with craggy edges were probably pushed along by glaciers, and those with rounded edges probably tumbled into position in giant floods that resulted when volcanic eruptions melted ice dams holding back sub-glacial lakes—in other words, in a *jökulhlaup*.

My colleagues and I focused on erratics tossed around by a monster flood that, it seems, for two or three days had carried water equivalent to one hundred times the average flow of the Amazon.[1] By chiseling off chips from each boulder and sending them to a lab for something called cosmogenic radionuclide exposure dating, we learned that this *jökulhlaup* happened about seven to ten thousand years ago, a keen disappointment to me.[2] I was hoping for a date recent enough to register in the human history of Iceland, which began only about 1,150 years ago, and for a research project to which historians might be able to contribute. But as disappointments go, this was an agreeable and interesting one: I found it fascinating to try to reconstruct the past from rocks rather than written records.

Before leaving Iceland in defeat, I visited the national museum in Reykjavik and

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[1] The Amazon's average flow is 209,000 cubic meters per second. This *jökulhlaup*, to judge by the size of boulders it moved, their elevations, and the size of canyons it helped to carve, had a maximum flow of 22 million cubic meters per second. That estimate appears in Douglas A. Howard, Sheryl Luzzadder-Beach, and Timothy Beach, "Field Evidence and Hydraulic Modeling of a Large Holocene Jökulhlaup at Jökulsá á Fjöllum Channel, Iceland," *Geomorphology* 147–148 (2012): 73–85.

[2] Neutrons from cosmic rays that bombard the earth can slowly alter the geochemical structure of rocks in a reaction called spalliation, allowing estimates of the length of time a given boulder's surface has been exposed to cosmic rays and has stood in the same position. Basalt boulders' calcite decays to Chlorine-36 under the neutron assault, and our chronological estimates derive from measurements of concentrations of Chlorine-36.

stumbled upon an exhibit concerning the early settlement history of Iceland. As recently as 2004, Icelandic scholars, working mainly from archaeological data, reckoned that Iceland's population was 60 to 90 percent Norwegian in origin.[3] The Icelandic Sagas, specifically the Book of Settlements or *Landnámabók*, written down some centuries after the events they describe, gave an even stronger sense of Norwegian origins, and that view was readily accepted among the population at large.[4]

But the museum exhibit told a different story. Using data collected from roughly half the Icelandic population of some 325,000, geneticists concluded that about two-thirds of the mitochondrial DNA—passed from mother to daughter—of current Icelanders bore a powerful resemblance to that in current Irish and Scottish populations. Only one-sixth of the DNA passed from father to son seemed to be from Scottish and Irish groups. The founding fathers were indeed mainly from Norway, as supposed, but not the founding mothers. The social origins of Iceland now looked more likely to involve Viking slavers and abducted women. The geneticists seemed to have succeeded in reconstructing a chapter of the past without written records. I was temporarily enraptured by the promise of what I later learned to call paleogenomics.

States of rapture rarely last. Not long after my visit to Iceland, I attended a talk in Munich, given by a geneticist who worked with human remains from late antiquity. Among the things she said in reference to genetic profiles, one in particular struck me then and has stayed with me since: "I can tell a German when I see one." This was uttered in a building roughly fifteen minutes, on foot, from the old Nazi Party headquarters building on Brienner Straße. The geneticist, I am sure, was no Nazi, and merely meant that it is possible to identify which ancient skeletons have the strongest genetic resemblance to modern German populations. But she seemed to equate *Germanii* of 1,600 years ago with modern Germans, and she sounded as if she sympathized with infamous efforts to essentialize and biologize ethnic and religious identities. What she seemed not to know about the resonances of her words astonished me. But then, if I had been speaking about genetics, what I would have seemed—with good reason—not to know would have astonished her.

I tell you these two stories because I am about to do what only my most reckless predecessors have done: speculate about the future of history. We are often told that technology will revolutionize the future. I wonder if it will revolutionize the past.

I will raise the question, without properly answering it, of whether or not we will reach a point that might be called "peak document," when the utility of research as we have long done it, with written texts, will begin to decline relative to research that uses other sorts of sources. I phrase this as I do in loose homage to the statistical studies of the oil industry by M. King Hubbert, who coined the term "peak oil" in 1956.

My question, then, is whether the *rate* of interesting and useful new historical discoveries derived from documents might peak and slowly decline. This is not to be con-

[3] Benedikt Hallgrímsson, Barra Ó Donnabháin, G. Bragi Walters, David M. L. Cooper, Daníel Guðbjartsson, and Kari Stefánsson, "Composition of the Founding Population of Iceland: Biological Distance and Morphological Variation in Early Historic Atlantic Europe," *American Journal of Physical Anthropology* 124, no. 3 (2004): 257–274.

[4] According to historian Magnus Magnusson, "The old idea was that they were all wonderful, pure-bred, nobly-born Norwegians fleeing from injustice and oppression who went to Iceland to set up the first republic in the world." Quoted in Iain Fleming, "Could Iceland's Biggest Star Really Be a Scot? Research Highlights New Theory on the Ancestry of the People of Iceland," *Mail on Sunday*, March 4, 2001.

fused with sheer volume of extant documents. The total volume of documents generated, and kept at least for a while, is surely set to grow. But the great majority of them will be trivial in the extreme, and even the most imaginative historians will find little of note in them, even if we grant, as we should, that what is not interesting and useful to one historian might be to another.

Put more fully, my question is: Will the odds of finding new documents that contain non-trivial information about history decline relative to the odds that such information will emerge from other kinds of sources? Will the odds also fall with each passing year that someone will reassess old documents in interesting new ways? Now and then, historians come up with new wrinkles that breathe new meaning into old and familiar documents. Indeed, this is what the most successful researchers in our profession have typically done, rather than find documents that no one has seen before. But each time it is done, it becomes harder for the next historian to do it.

Of course, we don't know what may be in secret and closed archives. If everything in them were trivial, their custodians would not bother to keep them closed. Moreover, new documents are made available every year, especially those of governments that have fifty-year rules or thirty-year rules. For recent diplomatic, military, and security history in particular, the continuing trickle of releases, assuming it is not shut off, will shield scholars from the possible approach of "peak document." And there is another possibility, a counter-trend, to consider: that digitization of archives will raise the odds that documents are interpreted in new ways because more researchers will have a chance to see them. This seems likely to me, and would have the effect of delaying "peak document."[5]

So, while I am not sure that "peak document" will necessarily arrive, the possibility that it might tempts me to explore some possible implications for historical research given the "flood"—as I will often refer to it—of new information about the human past that has lately come, and will come in greater measure in the years ahead, from tools and techniques of the natural sciences, rather than from reading what was written on pieces of paper, parchment, or papyrus.

MOST AHA PRESIDENTIAL ADDRESSES over the past 135 years have conformed to one of two models. The first is the research talk, or perhaps current research combined with reflections upon a career of research. This approach has the merit that the speakers usually know a lot about their subject. The second model consists of reflections upon the profession of history. The reflection model, in turn, has two sub-forms: the retrospective, normally "what has happened to the profession since I joined," and the sermon, essentially "here's what historians ought to do."[6] Andrew Dickson White in 1884–1885 and Charles Andrews in 1924–1925 gave both a retrospective and a research talk—in Andrews's case because his predecessor, Woodrow Wilson, died before he could give his address.

[5] Digitization of archives, which I will not explore here, will surely have interesting impacts on the processes of research, not least by driving historians to certain easily accessible collections rather than others that require travel and expense.

[6] Crane Brinton in 1963 referred to several of his predecessors' addresses as sermons. All previous AHA presidential addresses are available at https://www.historians.org/about-aha-and-membership/aha-history-and-archives/presidential-addresses.

In the early years of the AHA, the reflective sermon was much the preferred approach. James Ford Rhodes in 1899, to give but one example, lamented that no nineteenth-century historians matched the insight of Thucydides and Tacitus and judged that the entire output of historians since Herodotus was less valuable than the works of Shakespeare—this from a scholar whose office obliged him to promote the interests of historians!

The early addresses were often only one-third as long as the average since the 1950s. The champion of brevity was Henry Adams, whose assessment of "The Tendency of History" in 1894 came in at 2,600 words—this from a scholar who had written a nine-volume history of the U.S. when the nation's history was only half as long as it is now. Adams mailed it in—literally, as he was at sea, somewhere between Mexico and Tahiti, at the time of the annual meeting.[7] I will match neither his concision nor his nonchalance.

The reflection on history fell out of fashion by the 1930s, excepting a brief revival between 1957 and 1962. William Langer argued in 1957 that "The Next Assignment" for historians should be to take up psychoanalytic frameworks, specifically Freud. Carl Bridenbaugh in 1962 felt that history had genuflected too deeply in the direction of the social sciences and was at risk of losing its audience. Almost none since 1962 have returned to the tradition of the AHA's early years.[8] I intend to depart from the modern trend and revert to the older approach, but at the same time to be more cautious than my courageous sermonizing predecessors. I will try to keep prescriptions to a minimum. But I am going to reflect on what is happening in historical research, or perhaps I should say, *to* historical research, and to the historical profession, in general.

MANY CHANGES ARE AFOOT in our research habits. The roster of topics deemed worth researching is always churning, and I would guess always expanding. Changing social and political concerns help to determine what historians regard as worth their while. That has always been true and will remain so.[9] I will speak about a different change, one that I judge to be potentially revolutionary and, like many revolutions, fraught with peril as well as filled with promise.

Paleogenomicists, paleoclimatologists, paleopathologists, paleo-everything are flooding the scientific landscape with new information about the human past and other pasts that infringe upon the human. So are archaeologists armed with new tools. I should stress that this revolution, if it proves to be that, is already well underway.

And, I should also stress, it is a development not so alien to certain groups of histori-

[7] Former diplomat James Angell in 1893 needed only 3,600 words to do justice to his theme, "The Inadequate Recognition of Diplomatists by Historians." He was president of the University of Michigan for thirty-eight years, and no doubt learned the virtue of short speeches.

[8] However, Louis Harlan in 1989 offered a variation on the venerable tradition, reflecting on "The Future of the American Historical Association," in an address nearly as brief as Adams's—perhaps he thought the AHA had a short future ahead of it. (He recommended higher dues.) Almost all of the presidential addresses, whether research talks, retrospectives, or sermons, have appeared in the *AHR*, probably lowering its impact factor. Mine will doubtless lower it further. Carl Becker's "Everyman His Own Historian" (1931) has 600+ citations to its various editions according to Google Scholar, which probably tops the list among presidential addresses.

[9] The surge of work in climate history is a response both to the availability of new information and to the rise of anxieties about climate destabilization.

ans who have long worked with few or no written sources. Africanists focused on periods prior to 1800 have for decades summoned considerable ingenuity to work with oral traditions, archaeology, historical linguistics, and other tools of their trade rarely needed by those of us who work in document-rich environments. Indeed, one Africanist, Wyatt MacGaffey, referred to training in precolonial African history as a "decathlon."[10] To some extent, what I think might be coming represents an "Africanist-ization" of our discipline of history.[11] I will offer a few examples before speculating on the implications of it all.

MOST OF US ARE AWARE that beginning in 1998, DNA analysis of living persons helped shift the prevailing view as to whether or not Sally Hemings's six children were fathered by Thomas Jefferson. Genome sequencing, begun in the 1970s, got a lot cheaper and better after 2005 because of a revolutionary technical advance known as next generation sequencing.[12] No longer must geneticists have a case with the star power of the Jefferson-Hemings debate to justify the expense of doing historical work that will not help cure diseases.

One arena in which paleogenomics has earned its salt is disease history. Retrospective diagnoses based on texts are always risky, allowing, for example, skeptics to maintain that the Black Death pandemic of the mid-fourteenth century was something other than plague. That debate is now resolved, thanks to multiple ancient DNA (aDNA) diagnoses of Black Death victims, notably in London's East Smithfield cemetery. Genome-scale study of plague in recent years has revealed much that written sources could not: that the pathogens behind the Black Death and the Justinianic Plague of the 540s were extremely similar, and that both originated in Central Asian plague reservoirs.[13]

Another moment in disease history that looks a little different in light of new genetic evidence is the Columbian Exchange after 1492. Data extracted from Peruvian mummies makes it clear that human tuberculosis existed among pre-Columbian Americans by 1000 C.E. and was not among those infections introduced from Eurasia or Africa. However, typhoid, or something very much like it, not previously prominent on the roster of introduced diseases, seems to have wrought havoc on the people of Central Mexico in the sixteenth century. The main lines of the prevailing narrative about dis-

[10] Wyatt MacGaffey, "African History, Anthropology, and the Rationality of Natives," *History in Africa* 5 (1978): 101–120, here 103.

[11] In his 1998 address, the late Joe Miller, one of three Africanists to serve as AHA president, argued for the legitimation of history without documents and without precise chronologies.

[12] A helpful primer for people like me who can't tell a molecular clock from a phylogenetic tree is *DNA for Archaeologists* by Elizabeth Matisoo-Smith and K. Ann Horsburgh (London, 2016). A more up-to-date but more demanding overview is Charlotte Lindqvist and Om P. Rajora, eds., *Paleogenomics: Genome-Scale Analysis of Ancient DNA* (Cham, Switzerland, 2019). An accessible primer on genetics generally is Kostas Kampourakis, *Making Sense of Genes* (Cambridge, 2017). There are two main approaches to using genetics to illuminate history. One is to recover ancient DNA from human (or plant or animal or microbial) remains. The other is to draw inferences from the distribution of genetic markers within today's populations.

[13] A useful summary of recent plague work appears in Sharon N. DeWitte and Maryanne Kowaleski, "Black Death Bodies," *Fragments: Interdisciplinary Approaches to the Study of Ancient and Medieval Pasts* 6 (2017): 1–37, http://hdl.handle.net/2027/spo.9772151.0006.001. See also Maria Spyrou, Kirsten I. Bos, Alexander Herbig, and Johannes Krause, "Ancient Pathogen Genomics as an Emerging Tool for Infectious Disease Research," *Nature Reviews Genetics* 20 (2019): 323–340.

ease in the Columbian Exchange may well hold up; some of the details are changing already.[14]

Fast-forwarding hastily, and leaving disease history behind for the moment, DNA analysis can help illuminate the under-documented world of enslaved people in the Chesapeake. Saliva absorbed into the clay of an early-nineteenth-century tobacco pipe indicates that one smoker on the Belvoir plantation, just outside Annapolis, Maryland, was a woman probably of, or descended from, the Mende people in what is now Sierra Leone. No document tells us that. Extant documents from the Belvoir plantation tell us mainly about the plantation owners.[15]

Fast-forwarding again, Spain has about 120,000 decaying bodies in mass graves dating from the 1936–1939 Spanish Civil War. Fierce arguments rage about who massacred whom. In 2011 a Spanish government saw fit to close the archives that contain records relevant to murders by Franco's wartime supporters. However, multidisciplinary teams from the Asociación para la Recuperación de la Memoria Histórica have in recent years undertaken extensive DNA work on skeletal remains to try to ascertain the family identities of the murdered. The documents may or may not exist to resolve the mysteries that the geneticists and archaeologists address, and those documents may or may not become available depending on future political winds. But in any case it is the DNA, not the documents, that lately has been shedding light on these matters.[16]

Returning to the arena of disease history, and fast-forwarding one last time, a 1987 book that sold 700,000 copies and was made into a movie identified an Air Canada flight attendant as "Patient Zero," the person primarily responsible for spreading HIV in the United States in the early years of the AIDS epidemic. Decades after his death, that interpretation has been decisively refuted by genomic sleuthing. HIV was in the U.S. well before he helped to spread it, indeed even before the AIDS epidemic was recognized in 1981.[17]

A field that parallels paleogenomics is proteomics, or the study of proteomes—the full set of proteins made by a given organism. Proteins exist in unimaginable profusion and can now be chemically analyzed quickly and cheaply (compared to five years ago). It is, apparently, possible to ascertain that a particular late medieval Bible brought to Milan from China was made from calfskin in southern France. Proteomics also tells us that the registry pages that record deaths in Milan during the plague year of 1630 are peppered with proteins derived not only from *Yersinia pestis*, the plague pathogen, but also from chickpeas, rice, carrots, maize, and tobacco—a window into the consumption

[14] Kirsten I. Bos, Kelly M. Harkins, Alexander Herbig, and Mireia Coscolla, "Pre-Columbian Mycobacterial Genomes Reveal Seals as a Source of New World Human Tuberculosis," *Nature* 514 (2014): 494–497; Åshild J. Vågene, Alexander Herbig, Michael G. Campana, Nelly M. Robles García, Christina Warinner, Susanna Sabin, Maria A. Spyrou, et al., "*Salmonella enterica* Genomes from Victims of a Major Sixteenth-Century Epidemic in Mexico," *Nature Ecology & Evolution* 2 (2018): 520–528.

[15] Julie Schablitsky, Kelsey E. Witt, Jazmín Ramos Madrigal, Martin R. Ellegaard, Ripan S. Malhie, and Hannes Schroeder, "Ancient DNA Analysis of a Nineteenth Century Tobacco Pipe from a Maryland Slave Quarter," *Journal of Archaeological Science* 105 (2019): 11–18.

[16] Asociación para la Recuperación de la Memoria Histórica, https://memoriahistorica.org.es/. DNA work has become important to law enforcement in recent years as well.

[17] Randy Shilts, *And the Band Played On: Politics, People, and the AIDS Epidemic* (New York, 1987). Shilts was a journalist, not a historian, but his book won praise for its extensive research. Michael Worobey, Thomas D. Watts, Richard A. McKay, Marc A. Suchard, Timothy Granade, Dirk E. Teuwen, Beryl A. Koblin, et al., "1970s and 'Patient 0' HIV-1 Genomes Illuminate Early HIV/AIDS History in North America," *Nature* 539 (2016): 98–101.

habits of the city's clerks. Those pages also include microbiological signatures of rats and mice that lived in the Milan archive and inspected the registry closely, presumably hoping for a tiny meal of chickpea or rice. Proteins on postcards received and handled by the author Anton Chekhov betray residues of the tuberculosis bacterium (Chekhov died of TB at age forty-four). Studies of the proteins inadvertently inscribed onto paper can tell us something that the deliberately inscribed text does not. Conservators at the Folger Library in Washington, D.C., are now wondering whether they should preserve the dust on old manuscripts.[18]

These are a mere scattering of examples that happened to come to my notice in the months after I chose my topic for this address. They illuminate ancient, modern, and contemporary history. They range from microhistory—the identity of a single enslaved woman in Maryland—to generalizations about the largest pandemic in human history, and everything in between. There are thousands of other historical subjects, great and small, on which natural scientists are having their say—indeed, a few of them appeared in an AHA plenary session at the AHA meeting in Chicago in 2019, and a few more were on the 2020 program in New York.

Archaeologists for decades have embraced, with greater or lesser enthusiasm, the use of the natural sciences in their work. Lately they have acquired a new tool: Light Detection and Ranging, or LiDAR. LiDAR is a form of remote sensing undertaken from airplanes, helicopters, or drones buzzing overhead. Sensors receiving reflected laser beams measure the distance to features on the ground, which are then translated into digital 3-D images.

LiDAR can detect tiny differences (a few millimeters) in ground elevation and can do so through every hole in a forest canopy, no matter how narrow. In forested settings, it finds many things that archaeologists cannot see when walking the ground: low mounds, foundations, roads, and other permanent structures not visible through thick mats of vegetation. LiDAR is cheap compared to the price of employing armies of survey archaeologists, and getting cheaper.

Since 2010, LiDAR has been revolutionizing understandings of the past in Central America, Amazonia, Southeast Asia, and other landscapes now partly covered with forest canopy. It has not yet had similar impacts in Africa, but it likely will. Archaeologist Francisco Estrada-Belli likens LiDAR's impact in Central America to the Hubble Telescope's effect on astronomy.[19] It reveals that settlement, building, and cultivation were much more extensive than archaeologists had supposed prior to the advent of LiDAR.

[18] Alfonsina D'Amato, Gleb Zilberstein, Svetlana Zilberstein, Benedetto Luigi Compagnoni, and Pier Giorgio Righetti, "Of Mice and Men: Traces of Life in the Death Registries of the 1630 Plague in Milano," *Journal of Proteomics* 180 (2018): 128–137; Alfonsina D'Amato, Gleb Zilberstein, Svetlana Zilberstein, Mikhail Ivanovich Golovan, Anastasiya Anatolyevna Zhuravleva, and Pier Giorgio Righetti, "Anton Chekhov and Robert Koch Cheek to Cheek: A Proteomic Study," *Proteomics* 18, no. 9 (2018), https://doi.org/10.1002/pmic.201700447. I was led to this work by an article in the *New Yorker*, which omits D'Amato, the lead author of the scientific papers in question. Sam Knight, "Do Proteins Hold the Key to the Past?," *New Yorker*, November 19, 2018, https://www.newyorker.com/magazine/2018/11/26/do-proteins-hold-the-key-to-the-past.

[19] "Sprawling Maya Network Discovered under Guatemala Jungle," BBC News, February 2, 2018, https://www.bbc.com/news/world-latin-america-42916261. In this article, archaeologist Stephen Houston calls the new laser technology "one of the greatest advances in over 150 years of Maya archaeology."

Lowland Maya population estimates of the Classic Period (ca. 250–900 C.E.) are much higher now than they were just a few years ago—7 to 11 million people, and some specialists say 10 to 15 million. These upward revisions are based on extrapolations from a few sites, such as Caracol in today's Belize, where settlements have turned out to be eight times larger than imagined prior to LiDAR surveys.[20] Last year LiDAR revealed 60,000 stone features, mainly platforms on which Maya thatch huts typically stood, in 2,100 square kilometers of Guatemala's swampy Petén.[21] The Bird of Paradise settlement site, also in Belize, was revealed, four months ago, to be five times larger than scholars had previously recognized.[22] More revelations are yet to come, because thus far LiDAR surveys cover only about 10 percent of the lowland Maya region.

In the thick forests of Cambodia, LiDAR has yielded results nearly as revolutionary. The extent of low-density urbanization and engineered spaces at Angkor Wat is, it now appears, substantially greater than formerly understood—despite decades of painstaking archaeological work at Angkor. Entirely new cities of the Angkor culture have, so to speak, emerged from the forest.[23]

In southern Amazonia, new research using LiDAR suggests that pre-Columbian population density was about 2.5 times greater than prior estimates for a region the size of California. Villages were not clustered only along the bigger rivers, as once hypothesized, but scattered more widely. LiDAR also shows that people throughout all of southern Amazonia dug similar ditched enclosures, implying a degree of cultural interaction among peoples often thought to be isolated.[24]

Even in South Africa, where the vegetation is not dense tropical forest, LiDAR has lately opened new vistas. The Tswana settlement at Kweneng, about 30 kilometers south of Johannesburg, included about 900 houses, probably not all inhabited at the same time, and lasted from about 1400 to a little after 1800. Archaeologists had known of Kweneng before but had drastically underestimated its extent. They now regard it as a capital of a Tswana polity that was probably destroyed by warfare early in the nineteenth century.[25]

On a smaller scale, LiDAR has helped scholars find walls and building foundations from seventeenth- and eighteenth-century Connecticut and Massachusetts that lie be-

[20] Arlen F. Chase, Diane Z. Chase, and John F. Weishampel, "Lasers in the Jungle," *Archaeology* 63, no. 4 (2010), https://archive.archaeology.org/1007/etc/caracol.html.

[21] "Sprawling Maya Network Discovered under Guatemala Jungle."

[22] Timothy Beach, Sheryl Luzzadder-Beach, Samantha Krause, Tom Guderjan, Fred Valdez Jr., Juan Carlos Fernandez-Diaz, Sara Eshleman, and Colin Doyle, "Ancient Maya Wetland Fields Revealed under Tropical Forest Canopy from Laser Scanning and Multiproxy Evidence," *PNAS: Proceedings of the National Academy of Sciences* 116, no. 43 (2019): 21469–21477.

[23] Damian Evans, Roland J. Fletcher, Christophe Pottier, Jean-Baptiste Chevance, Dominique Soutif, Boun Suy Tan, Sokrithy Im, et al., "Uncovering Archaeological Landscapes at Angkor Using Lidar," *PNAS* 110, no. 31 (2013): 12595–12600. In another article, Evans is quoted as saying, "We have entire cities discovered beneath the forest that no one knew were there," and "All of a sudden, the city has more or less instantly appeared on the screen in front of us. It had been hiding in plain sight. A city that we figured wasn't there just appeared." Jason Daley, "Laser Scans Reveal Massive Khmer Cities Hidden in the Cambodian Jungle," *Smithsonian*, June 14, 2016, https://www.smithsonianmag.com/smart-news/laser-scans-reveal-massive-khmer-cities-hidden-cambodian-jungle-180959395/.

[24] Jonas Gregorio de Souza, Denise Pahl Schaan, Mark Robinson, Antonia Damasceno Barbosa, Luiz E. O. C. Aragão, Ben Hur Marimon Jr., Beatriz Schwantes Marimon, et al., "Pre-Columbian Earth-Builders Settled along the Entire Southern Rim of the Amazon," *Nature Communications* 9 (2018), https://doi.org/10.1038/s41467-018-03510-7.

[25] Karim Sadr, "Kweneng: A Newly Discovered Pre-Colonial Capital near Johannesburg," *Journal of African Archaeology* 17, no. 1 (2019), https://doi.org/10.1163/21915784-20190001.

neath regrown woods. This will not likely change our understandings of colonial New England except in small detail. Anyone who has walked in those woods already knows there are stone walls everywhere. But it is another indication that LiDAR can reveal new things even in landscapes that have been carefully combed over by archaeologists.[26]

LiDAR's potential for revising history in now-forested regions, especially in Central America, Amazonia, equatorial Africa, Southeast Asia, and Oceania, holds great promise. As the technology gets cheaper, the rate at which interesting discoveries are made will quicken.

New scientific instruments permit the study of formerly invisible evidence not only beneath forest canopies but right under our noses—in the tiny layers on our teeth. Electron microscopes, first developed in the 1930s, have also improved lately, although not with the same sudden leaps as in genomic sequencing or LiDAR. They now magnify images about 5,000 times more than the best light microscopes. (A good one costs well over $100,000.) Recently, magnification of 10 million to 50 million times has become possible. With this new power, one can see the individual layers that growing teeth put on every day. Like annual rings of trees, these layers provide a datable record of conditions for growth. From their second trimester in the womb, fetuses begin to make teeth, and most people's teeth continue to grow until about age twenty. The thin layers on either adult or baby teeth register stress and nutrition on a daily basis, almost like a diary. Study of the daily dental layers makes fetal and childhood health history accessible in the absence of texts. Baby teeth betray the nutritional stress of weaning, which shows up especially well as dark bands in tooth enamel, allowing strong inferences about ages at which infants were weaned in past societies—if one has enough teeth to work with. According to Tanya Smith in *The Tales Teeth Tell*, it is even possible to infer from teeth how many times a woman gave birth before the age when her teeth stopped taking notes. Tooth enamel is the hardest part of our bodies and endures very well, providing entrée to the deeper past.

Tooth layers also contain evidence of recent history. They record the daily uptake of radioactivity from atmospheric nuclear testing. Those of us born after 1945 and before the 1963 partial test ban treaty carry around a chronology of nuclear testing in our mouths. With enough teeth, it would be possible to reconstruct the geography of radiation exposure on a day-to-day basis from the era of atmospheric nuclear testing.[27]

[26] Katharine M. Johnson and William B. Ouimet, "Rediscovering the Lost Archaeological Landscape of Southern New England Using Airborne Light Detection and Ranging (LiDAR)," *Journal of Archaeological Science* 43 (2014): 9–20.

[27] Tanya M. Smith, *The Tales Teeth Tell: Development, Evolution, Behavior* (Cambridge, Mass., 2018), especially chaps. 1–3 and p. 217. Even less powerful microscopes can measure the distance between ridges on a fingerprint. Why might one do so? Because men have, on average, a 9 percent wider gap between the ridges in their fingerprints than do women. And with this knowledge and a lot of potsherds retaining fingerprints impressed into wet clay long ago, it is possible to infer that between 800 and 1200 at Chaco Canyon in New Mexico, 47 percent of pots were made by men and 40 percent by women (in 13 percent of cases no judgment can be made), shattering a longstanding assumption that pottery was women's work. Michelle Z. Donahue, "Fingerprint Study Upends Ideas about 'Women's Work' in Ancient America," *National Geographic*, June 3, 2019, https://www.nationalgeographic.com/culture/2019/06/fingerprint-study-gender-ancient-chaco-canyon/.

Constraints, including the ghost of Henry Adams, prevent me from exploring several more ways in which new tools and techniques from the natural sciences open new possibilities for the study of history. But I should at least mention in passing some of what I must otherwise ignore, at least with regard to the advent of supercomputers. Supercomputers confer new power upon historical linguistics, making inquiries feasible that once were too laborious to contemplate.[28] So too with climate reconstruction and paleoclimatology, where computer climate modeling combined with the use of natural proxies—tree rings, fossil pollen, corals, ice cores, speleothems, and so forth—allows more precise and confident work than ever before, and on more local scales.[29]

Perhaps the ultimate application of enhanced computer power will be in the form of artificial intelligence (AI). So far as I can tell, it has yet to have much impact on historical research other than powering Google Scholar. It is good at identifying ancient Chinese ceramics and completing damaged ancient Greek and Latin epigraphs.[30] One day soon, however, the U.S. National Archives will probably be using AI to determine which government documents to preserve and which to destroy. Koreans are using AI to help with a different document problem: until the twentieth century, a huge proportion of the documents that reflect their history were written in Chinese. The Institute for the Translation of Korean Classics in Seoul has embarked on human translations of a single set of these records and expects it to take more than 150 years' work on the part of teams of bilingual experts. At the same time, the institute is teaming up with the Korean Astronomy and Space Science Institute to train computers to recognize patterns in strings of Chinese characters, then review all the extant Korean translations of those strings, and select the most probable one. If it works, this will make the documentary records of Korean history accessible to ordinary Koreans within decades rather than centuries.[31]

It is hard to imagine, however, that artificial intelligence will not profoundly affect procedures of research in history. It excels at pattern recognition, which is a large part of what historians do. While I am eager to see what LiDAR or paleogenomics will reveal next, I confess that I do not look forward to the day when AI can do historical research as well as or better than you and I.

THE MOUNTING FLOOD OF historical evidence from the natural sciences holds some implications for historians. First, the mounting flood will probably have a modest demoticiz-

[28] Johann-Mattis List, Simon J. Greenhill, and Russell D. Gray, "The Potential of Automatic Word Comparison for Historical Linguistics," *PLoS ONE* 12 (2017): e0170046, https://doi.org/10.1371/journal.pone.0170046.

[29] Speleothems are mineral deposits found in caves, such as stalagmites and stalactites. Their oxygen and carbon isotopes can contain clues about past temperature and rainfall for the last few hundred thousand years.

[30] Tianhong Mu, Fen Wang, Xiufeng Wang, and Hongjie Luo, "Research on Ancient Ceramic Identification by Artificial Intelligence," *Ceramics International* 45, no. 14 (2019): 18140–18146; Gege Li, "DeepMind AI Beats Humans at Deciphering Damaged Ancient Greek Tablets," *New Scientist*, October 18, 2019, https://www.newscientist.com/article/2220438-deepmind-ai-beats-humans-at-deciphering-damaged-ancient-greek-tablets/.

[31] Geunhye Hong, "The Translation of Historical Documents and the Study of Korean History Using Artificial Intelligence," *International Journal of Korean History* 24, no. 2 (2019): 71–97. The ultimate outcome of this effort remains to be seen. It will surely reduce the incentive among Korean historians to spend ten years learning Chinese, and it will probably produce translations that miss some irony and wordplay.

ing influence upon history in one sense. As we historians often point out, texts are likelier to offer the voices of the powerful than of the powerless. This is probably less true of LiDAR, paleogenomics, tooth layer studies, and historical linguistics. LiDAR reveals the humble pavements in the forest where previously only pyramids and palaces protruded from the canopy. Paleogenomics and historical linguistics address the behavior of communities more than of individuals.

What might the flood mean for various periods of history? First, it should lengthen our sense of history. Texts go back about 5,000 years. LiDAR lets us glimpse the human past for as long as people have built things of earth and stone, which in practice means a few thousand years. Some practitioners of historical linguistics think their evidence can reach back 8,000 years or more. Ancient DNA, at present, can extend our vision back about 70,000 years, and inferences based on genomes of people alive today are useful for the entire history of our species and those ancestral to us. Paleoclimatology also reaches into the past far beyond the origins of our species. Previous generations of historians regarded the distant past as prehistory and recognized history as beginning only with writing. This distinction was never useful and now is increasingly absurd. It should have been swept into the dustbin of history with the advent of radiocarbon dating in the late 1940s. With far more tools available, the concept of prehistory has long outlived any usefulness it might once have had.

Will we in the fullness of time find that the most exciting things to study in history are from longer ago? My guess is that the answer will more often be yes, despite the fact that there is much that these new and enhanced tools, and those yet to be invented, surely cannot illuminate; and the additional fact that for many among us, the world of our parents and grandparents will always be more interesting than that of unknown people centuries or millennia ago. Intellectual excitement will, if this guess is correct, migrate in the direction of periods for which documents are fewer and the relative significance of information in other formats is greater. The most exciting eras will probably be those for which only a smattering of evidence exists, as with early Iceland, around which historians for 150 years have built interpretations. Those interpretations will sometimes stand up well in the light of new data, will sometimes be called into question, and perhaps will sometimes be decisively undermined.[32]

The last century or two are the best documented with texts and will presumably be least affected by the flood of findings from non-textual sources. The American Civil War, the subject of 65,000 books, will not soon lose its luster, I am sure, but its historians will get less outside help in their struggle to say something new about it than will historians of pre-Columbian America or precolonial Africa. Or so I think. But who knows what proteomics might reveal about the Civil War?

What might the mounting flood mean for geographic fields, rather than periods, of

[32] At present, molecular biologists and geneticists tussle with archaeologists and anthropologists over whose data and perspectives are more meaningful, often over the relative significance of migration (geneticists like it) versus transmission of cultural traits (archaeologists like it) in explaining cultural change. A recent example is the idea of a near-wholesale replacement of the population of Bronze Age Britain though in-migration at the time of the advent of bell beaker ware. These tussles produce excitement, albeit in this instance more so in Britain than elsewhere. Iñigo Olalde, Selina Brace, Morten E. Allentoft, Ian Armit, Kristian Kristiansen, Nadin Rohland, Swapan Mallick, et al., "The Beaker Phenomenon and the Genomic Transformation of Northwest Europe," *Nature* 555 (2018): 190–196. For frictions between geneticists and archaeologists in general, see Ewen Callaway, "Divided by DNA: The Uneasy Relationship between Archaeology and Ancient Genomics," *Nature* 555 (2018): 573–576.

history? Will it reshuffle the interest and novelty among domains of history, not only chronologically but also geographically? Will LiDAR help shift historians' attention to the (understudied) forested tropics if—as seems to be the case—bigger populations were living in more complex societies in places such as the Maya lowlands, Amazonia, and Southeast Asia than anyone previously believed? Historians have normally left these matters to archaeologists and anthropologists, but will we continue to cede that honor if these times and places appear more important to the human past? Once upon a time, historians behaved as if Africa had no history and left its study to others. Yet our forebears learned better. LiDAR, presumably, will do far less to revise the history of regions with less forest canopy, such as the Middle East or North China.

Will paleogenomics' impact have a geography to it as well? Probably yes. Where ethnic (or racial) identities and differences are held dear and understood as matters of ancestry, DNA evidence will often prove unsettling. People will conscript it in favor of their preferred views of themselves and others where that can plausibly be done. And where it can't, where it contradicts someone's cherished ideas on ethnic or racial identity, the authority of genetic evidence will be disputed. India is an example: some Indians, including scholars, take a dim view of genetic evidence that implies that there was substantial migration into India from Iran and Central Asia during the Bronze Age, while others cheerfully accept it.[33]

Beyond that, the availability of the raw material for paleogenomics varies from place to place for reasons of both physical geography and culture. Ancient DNA, whether human or of any other sort, survives poorly where heat, humidity, and soil acidity are high. Burial customs also affect the likelihood of human DNA preservation. Societies in which cremation predominated over burial left little for any hunters of human aDNA to find. The patchiness of paleogenomic geography will likely proceed not merely from preservation potential: some peoples, understandably, prefer that their ancestors be respectfully left in peace rather than subjected to genetic examination by strangers.[34]

Paleogenomics based on analysis of living people will likely also shed only dappled light on history. Some people are eager to see their genetic material studied, and others recoil at the prospect. But there could well be larger patterns than personal preference, patterns shaped by culture and economics. Can one imagine one-third of Americans agreeing, as Icelanders have done, to have their genetic profiles examined in the (alleged) interest of public health? Where suspicion of authority, of expertise, and of science runs high, cooperation in such matters is likely to run low. I can imagine great dif-

[33] On India, see, e.g., Analabha Basu, Neeta Sarkar-Roy, and Partha P. Majumder, "Genomic Reconstruction of the History of Extant Populations of India Reveals Five Distinct Ancestral Components and a Complex Structure," *PNAS* 113, no. 6 (2016): 1594–1599. A review of the issue is Partha P. Majumder, "Understanding the Aryan Debate: Population Genetic Concepts and Frameworks," *Current Science* 114, no. 5 (2018): 971–975. For a general consideration of the politics of paleogenomic work, see Keith Wailoo, Alondra Nelson, and Catherine Lee, eds., *Genetics and the Unsettled Past: The Collision of DNA, Race, and History* (New Brunswick, N.J., 2012).

[34] Most famously, perhaps, in the case of "Kennewick Man," a 9,000-year-old skeleton found in 1996 in Washington State that became the subject of lawsuits involving the conflicting preferences of Smithsonian researchers and local Native American peoples—to whom he bore a strong genetic resemblance. For a history of skeleton collecting and its political contexts in the U.S., see Samuel J. Redman, *Bone Rooms: From Scientific Racism to Human Prehistory in Museums* (Cambridge, Mass., 2016). For both the scientific study of and the legal affairs regarding Kennewick Man, see Douglas W. Owsley and Richard L. Jantz, eds., *Kennewick Man: The Scientific Investigation of an Ancient American Skeleton* (College Station, Tex., 2014).

ferences in the willingness of populations around the world to cooperate in the gathering of DNA for testing purposes, and equally great differences in the price point at which they would overcome their mistrust and agree to sell a drop of blood or a swab of saliva.[35] And is it too Orwellian to imagine circumstances in which entire national populations, or some mistrusted minority groups, will be compelled to undergo genetic testing in the name of national health?

Next, how might the mounting flood affect thematic fields of history? LiDAR or paleogenomics will have little impact on intellectual history, I imagine, compared to the history of health, nutrition, disease, agriculture, settlement, urbanism, pastoralism, migration, climate adaptation, and so forth. But it is hard to know in advance how new tools and types of data will evolve and how historians' imaginations will make use of them. Maybe artificial intelligence will be a boon to intellectual history, automating the search for words and phrases in the corpus of digitized writing. Or maybe it will make intellectual history easier but not better.

The flood has already powerfully shaped some thematic fields, including environmental history. Banana trees, antelopes, and—my favorite example—mosquitoes leave no memoirs, and few documents say much about them. The people who installed sugar plantations in the seventeenth- and eighteenth-century Caribbean did not recognize that they were inadvertently creating good habitat for an introduced mosquito that serves as a highly efficient vector for the transmission of yellow fever. That mosquito is absent from all texts before the 1890s. So is the yellow fever virus. Yet both virus and vector were central participants in Caribbean history for 250 years until 1900, helping to shape millions of lives, settlement patterns, the volume of the transatlantic slave trade, military affairs, and political history—at least if you believe arguments I have offered.[36] Because of its emphasis upon the significance for human affairs of the history of nonliving things, environmental history stands to be disrupted, and with luck enhanced, more than most fields.

Health and disease history will also be among those fields most dramatically reconfigured by the mounting flood. Pathogens' genetic material can be recovered from human, animal, and plant remains, indeed from soil. LiDAR might recast urban history, by revealing evidence of old cities in new places. These expectations are merely extrapolations from current trends and do not allow for the unexpected—which is sure to come. In short, I anticipate that the coming flood will rearrange the fortunes of historical fields, whether defined by period, place, or theme.

BUT ENOUGH MUSINGS ABOUT intellectual directions. What might the meaning of all this be for the institutions and structures of history as a profession in this country? First,

[35] The practices and procedures surrounding human-subject research and DNA collection around the world are variable. Sometimes they involve payment or gifts, sometimes not. Ethical complexities abound.

[36] J. R. McNeill, *Mosquito Empires: Ecology and War in the Greater Caribbean, 1620–1914* (New York, 2010). I say "until 1900" because the etiology of yellow fever was by then unraveled, and its prevention proved comparatively easy in much of the Caribbean. One lab has recently shown that the yellow fever virus's chief vector mosquito is a recent African import to the Caribbean and the Americas: Jeffrey R. Powell, Andrea Gloria-Soria, and Panayiota Kotsakiozi, "Recent History of *Aedes aegypti*: Vector Genomics and Epidemiology Records," *BioScience* 68, no. 11 (2018): 854–860.

could it extend to the most inertia-bound precinct of our profession, the academic job market? Academic history jobs are described today much as they were fifty years ago: historian of imperial China, or colonial Latin America, or Africa, or the antebellum U.S. There are a few jobs with titles and descriptions that were unknown in 1970—gender historian, transnational historian—but they remain a tiny minority, and it is their subject matter, not their methods, that distinguishes them.

It is interesting to contrast this inertia (or consistency if you prefer) with what has happened in the discipline of geography in the same half-century. Back in 1970, and long before that, academic geographers also divvied up the world. There were regional geographers of Africa or Europe or Latin America. Nowadays, however, geography positions are increasingly not defined this way, but rather in terms of technical specialty—remote sensing, GIS, and so forth; and in terms of thematic specialty—biogeography, geomorphology, ocean-atmosphere interactions. On the faculty websites for five of the biggest and best geography departments in the country—the University of California at Berkeley, the University of Colorado, the University of Texas, the University of California at Santa Barbara, and Clark University—only between 5 percent and 40 percent of faculty mention a specific place in their website self-descriptions. And the younger they are, the less likely they are to do so. New tools have redefined the profession of geography, including its job market. Will new tools do the same to our profession? Will we in ten or twenty years be defining positions for historians adept in aDNA analysis, paleoclimatology, or historical linguistics? I don't know, and I never want to underestimate inertia. But it might already be happening with digital history.

If the flood continues to mount, and if "peak document" approaches, will we have to reconsider how we train future historians? For ages, many historians had to learn paleography or to absorb the findings of archaeology. In most fields we have always had to learn foreign languages, and in recent decades the industry standard in terms of the number of languages in some fields has risen to daunting heights. In the same decades, professional training came to include at least smatterings of quantitative skills, British social anthropology, or literary theory. All that seemed strenuous enough at the time. And now, the paleosciences! The specter of a fifteen-year Ph.D. program—a decapentathlon of training—looms.

How much of all this should historians-in-training seek to acquire? How much should be required of them? Opinions will vary, and will include the view that the right answer is zero—as was sometimes the view with respect to quantitative skills or literary theory. Of course, the effect of all this is not necessarily cumulative. Skills that once seemed important may now, or soon, seem less so. Not every historian needs every skill and tool. There are those among us who never use foreign languages or paleography. But it is not easy to know in advance exactly what one will need unless one somehow knows exactly what one will research over a lifetime. So training might need to broaden to include an even bigger quiver of techniques and tools.

Perhaps the formation of historians ought to be reimagined so as to include training sabbaticals after a career is underway. As one's interests evolve, one's toolkit needs to evolve. Sometimes even if one's interests remain constant, one still needs to understand new tools to keep up. Can we adjust our understanding of careers to accommodate that? Since 2002, the Mellon Foundation has awarded fellowships to between two and five historians annually for post-Ph.D. training in other disciplines. Could we find a

way to expand that by orders of magnitude? To make it a routine feature of a researcher's career?

Preparing some historians but not others to understand and use new research techniques deriving from the paleosciences carries certain risks. We might fall prey to our own version of the "two cultures" divide if some historians are trained only with texts while others are trained to work with geneticists and computational linguists.[37] Would enough commonality remain for history to endure as a discipline? So far we have weathered the diversification of interests, and modest diversification of methods, over the past 150 years. Accelerated diversification of methods will make that harder. If history as a discipline were to shatter into two (or more) cultures, I, at least, think that would be unfortunate—especially for whoever is president of the AHA at the time.

Do we have in place the right institutions to pursue historical research of the future? Universities, museums, public agencies, and other institutions have long had units that specialize in history. That has proved enormously fruitful. But if "peak document" is coming, perhaps the point of diminishing returns for such structures is as well.

There are a few groups and institutions trying to integrate text-based history and the paleosciences on a modest scale, probably more so in Europe than elsewhere.[38] I would like to see more efforts, more variety, so that we can find out more about what might work well and what does not. If I had the bank balance of a Bezos or a Buffett, of which there is little risk, I would be tempted to try to create several research institutes, all dedicated to the study of the human past by all available means.

If historical research comes to depend in larger proportion on expensive tools, what will that mean? Will it give an additional edge to the richly endowed institutions and heighten the obstacles for the rest, especially those historians working on their own? I fear it will. (Of course, a few years ago I thought MOOCs would do something similar to teaching, and so far I have been happily wrong.)

NEW TOOLS CREATE NEW HAZARDS, such as the neglect of limitations. Paleogenomics can never tell us what people thought about art or God. Few of the tools that I have mentioned are good for generating precise chronologies, an inevitable source of frustration for most historians. Some of the new tools may also discourage scholars from acquiring a sense of place. Historians, like geographers and anthropologists, often build up a useful familiarity over the years with a place and a culture. That is less likely to happen if one gathers one's information from datasets based on aDNA, climate proxies, or LiDAR.[39]

When reading what two economists have done with recently available genetic data, I am reminded of the adage that a little knowledge is a dangerous thing. Although with due respect to their formidable learning in some arenas, maybe in this case the adage should be amended to read: a lot of knowledge applied confidently in ignorance of all

[37] Other disciplines seem to struggle more than ours with methodological divides—biology, geography, and political science, for example.

[38] If so, U.S.-based historians are once again in a position of looking to Europe for guidance, as many AHA presidents of the 1880s and 1890s recommended.

[39] Lara Putnam suggests that this is happening with digitization of archival documents: Putnam, "The Transnational and the Text-Searchable: Digitized Sources and the Shadows They Cast," *American Historical Review* 121, no. 2 (April 2016): 377–402.

competing knowledge is a dangerous thing. With admirable mathematical rigor, they claim to show that the high genetic diversity of African populations (Ethiopians are apparently #1) and the low genetic diversity of Bolivians accounts for their respective economic histories, including the levels of prosperity achieved today. Because of the human exodus from Africa some 70,000 years ago and subsequent settlement of the globe, the geographical distance from Ethiopia creates a declining gradient of genetic diversity. That gradient, they maintain, shaped economic performance over millennia. There is, they maintain, a Goldilocks middle ground of genetic diversity, occupied by both Europeans and Asians, that is optimal for economic development. They calculate that adding 1 percent greater genetic diversity to the Bolivian population would raise GDP per capita by 30 to 40 percent. Lowering it by a mere 1 percent in Ethiopia would raise prosperity by about 20 percent. I am sure the authors are smart people. They have done well in the economics profession, and their work appears in one of the world's most prestigious economics journals. Yet this argument strikes me as ignorant and illogical in the extreme, a misuse of the work of geneticists. If Asians and Europeans share optimal levels of genetic diversity, how can one explain the divergent economic performances of Norway and Nepal? Perhaps I fail to understand their argument. And no doubt they would find some of my ideas wrongheaded and short on rigor, despite, in due course, their being published in the world's most prestigious history journal, the *AHR*.[40]

Inadequate appreciation of the complexities of other disciplines and lines of evidence creates a moonscape of potholes and pitfalls. Many scholars—myself included—are too often guilty of skating over the thin ice of unfamiliar disciplines. We tend to seek simplification, understandably, and to engage in oversimplification at times. We are guilty of an equivalent of seeing like a state—imposing a legibility upon the chaotic and messy, for otherwise we can't use the results of our colleagues' exciting work. There are limits to what we can know and understand due to the finiteness of our training and our lifetimes.[41]

To the extent that we become enthralled with the new flood, we redirect our attention to certain themes and subjects for which the new tools are helpful and away from others. An example is the tendency among climatologists to take new paleoclimatological information from ice cores and tree rings and concoct explanations of the rise and fall of Chinese dynasties that put climate at the center.[42] No one did so before the relevant climate data became available. No one should do so now. Preference for a familiar variety of evidence over all others is a recipe for trouble, even if it is a natural temptation.

Now, as I see it, this temptation is parallel to what most historians a century ago used to do: focus on those aspects of the past best illuminated by documents to the ne-

[40] Quamrul Ashraf and Oded Galor, "The 'Out of Africa' Hypothesis, Human Genetic Diversity, and Comparative Economic Development," *American Economic Review* 103, no. 1 (2013): 1–46.

[41] This vocabulary comes from James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, Conn., 1998).

[42] E.g., "It can be noted that the three long cold phases in the last millennium had brought about the collapse of the three longest dynasties: Song, Ming and Qing." David D. Zhang, C. Y. Jim, George C.-S. Lin, Yuan Qing He, James J. Wang, and Harry F. Lee, "Climatic Change, Wars, and Dynastic Cycles in China over the Last Millennium," *Climatic Change* 76, no. 3 (2006): 459–477, here 476. The authors are more restrained at other points in their article than in this sentence.

glect of all else. That resulted in a text fetish to which we are almost all heirs. Reliance on texts as the sole legitimate source for history led to exaggeration of the significance of bureaucratic (read: document-generating and document-keeping) states in human affairs, and to a sometimes scornful neglect of societies without much state apparatus. Moreover, the text fetish encouraged historians to neglect activities, such as those of family life, that held only modest interest for most states until recently.[43] Historians marched conscientiously along paper trails, with scarcely a glance to the side, and were drawn to suppose that there were indeed peoples without history. In any case, the new tools will also drive us along certain paths to the neglect of others, invite us to consider some subjects and not others, and it is as easy to lose sight of that limitation as it was for professional historians to work in thrall to a text fetish.[44]

At present, given how we are trained and conditioned, the best way to avoid pitfalls may be for historians to work in multidisciplinary teams, a practice at odds with long tradition and the confirmed habits of most of us. But surely our social skills, on average, are equal to those of economists and chemists. Indeed, handfuls of historians are already collaborating with geneticists, vulcanologists, computer scientists, and a range of other specialists. Such collaboration, I imagine, will always represent the safer path, even if our training expands by leaps and bounds in all directions.

Teamwork of this sort has its own pitfalls, of course. Multi-authored publications are, on average, clunkier for having been written by a team and involving countless compromises (I fancy myself as an authority on clunky co-authorship). Journals tend to have rules about formatting articles that differ considerably among the humanities, social sciences, and natural sciences, which can frustrate authors whose collaborations pull them across the borders. Most natural scientists wince at the thought of books. More fundamentally, teammates are rarely equal in voice and power. Some can bring big money to the table and some cannot. That affects the questions that get asked and the approaches taken to their solution.

Career incentives also can cloud collaborations. Some scholars and scientists are likelier than others to be able to get a paper accepted by *Nature* or *Science*. At the moment, paleogeneticists seem to have a leg up, and the broader their collaborations, the less likely they are to succeed in grasping that brass ring. Most paleoscientists would see no career value at all in placing an article in the *AHR* or any history journal. For those building a CV to get or keep a job, or even just to climb higher in the pecking order, it would amount to precious time wasted to engage in teamwork with historians unless the results conformed to the expectations of their own disciplines.

AT ONE LEVEL, THE MOUNTING FLOOD is disconcerting for an old dog—me—who cannot expect to learn new tricks properly. At another level, it is disconcerting for what it might mean for our profession in practical terms. It might put heavier demands on those

[43] This view is a faint echo of Carl Becker's 1930 AHA presidential address, in which he argued that history included the memory of all things done and said, including an office worker drinking a cup of coffee.

[44] A parallel preoccupation once reigned within archaeology. For a long period, monumental ruins drew the attention of archaeologists (and their donors) like nothing else. If there were no Parthenons or pyramids to be found in Amazonia, why invest in archaeology there? Archaeologists outgrew this perspective half a century ago, although their lay admirers and donors are not entirely free of it still.

seeking to become historians. It might make it harder for all but the richest institutions to practice history. It might drive a wedge between methodological hedgehogs and methodological foxes.[45] It might do many things that none of us can now foresee, some of them unwelcome.

Yet for all that, the mounting flood is also a thrilling prospect. It promises a giant expansion in our knowledge of the human past, and who among us cannot welcome that? The blending of textual and non-textual sources should eventually give us a fuller and finer history than we have been able to assemble so far. Much that seems settled will be challenged as new lines of evidence develop, and that is exciting, too. So I urge a full but cautious embrace of all the paleosciences, alert to the pitfalls. This seems far preferable to pretending that the flood is not upon us, going about our business as usual, and leaving the interpretation of paleoscientific data to others.

Historians must not be shy. We bring to the table skills and sensitivities that others often lack. We are by training alert to the complexities of causality and rarely enchanted by monocausal explanations. We are by training alive to context and comparison, almost instinctively assessing the plausibility of arguments and interpretations by making reference to other situations. We are by training aware that not everything that counts can be counted. We are experts in understanding how and why societies change and how people operate in groups. And of course we know the documents—where there are documents—and can blend, or help blend, textual evidence with paleoscientific data to achieve something akin to parallax vision. So we should not hesitate to offer our expertise at every opportunity when and where paleoscientists are at work reconstructing the human past.

One last word, which is in effect that there can be no last word. At some distant point in the future, new information from the paleosciences will peak, too. The rate at which new and interesting paleogenetic or paleoclimatological data appear will fall once most of the low-hanging fruit is grabbed. What happens to the practice of history then? I haven't a glimmer, but maybe, just maybe, the *relative* significance of documentary sources might make a comeback.

[45] Isaiah Berlin, following the seventh-century B.C.E. poet Archilochus, divided thinkers into foxes, who know many things and see with many lenses, and hedgehogs, who know one big thing and see everything through one lens. Berlin, *The Hedgehog and the Fox* (London, 1953). The field of African history seems not to have suffered such divisiveness, which is encouraging. But a shared sense of marginalization within the larger discipline might provide a glue that is not available to history as a whole.

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