# HPS&ST Note

March 2018

## Introduction

This HPS&ST monthly note is sent direct to about 7,450 individuals who directly or indirectly have expressed an interest in the contribution of history and philosophy of science to theoretical, curricular and pedagogical issues in science teaching, and/or interests in the promotion of innovative and more engaging and effective teaching of the history and philosophy of science. The note is sent on to different international and national HPS lists and international and national science teaching lists. In print or electronic form it has been published for 20+ years.

The note seeks to serve the diverse international community of HPS&ST scholars and teachers by disseminating information about events and publications that connect to concerns of the HPS&ST community.

Contributions to the note (publications, conferences, opinion pieces, etc.) are welcome and should be sent direct to the editor:

Michael R. Matthews, UNSW, m.matthews@unsw.edu.au.

The Note, along with RESOURCES, OBITUARIES, OPINION PIECES and more, are lodged at the website:

http://www.hpsst.com/

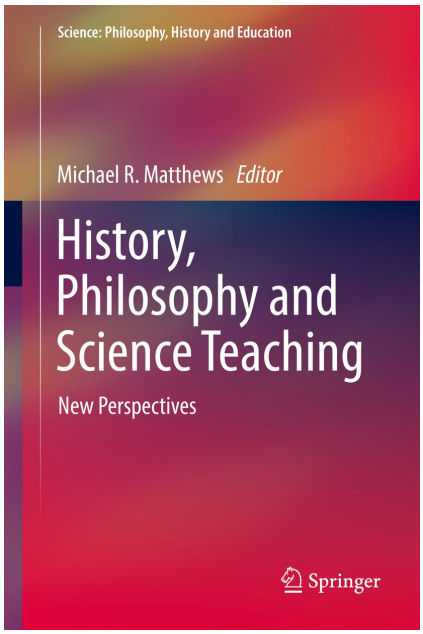
## History, Philosophy, and Science Teaching: New Perspectives

Michael R. Matthews (ed.), Springer 2018. ISBN 978-3-319-62614-7

The anthology of 326 pages has 12 chapters in four sections.

> This book is a timely reminder of why history and philosophy of science are urgently needed to support understanding of science. From major traditions such as the Enlightenment to the tensions around cultural studies of science, the book provides a comprehensive context for the scientific endeavour, drawing on curriculum and instructional examples. – Sibel Erduran, University of Oxford, UK

The scholarship that each of the authors in this volume offers deepens our understanding of what we teach in science and why that understanding matters. This is an important book exploring a wide set of issues and should be read by anyone with an interest in science or science education. – Jonathan Osborne, Stanford University, USA




This volume presents new and updated perspectives in the field, such as the Enlightenment Tradition, Cultural Studies, Indoctrination in Science Education, and Nature of Science. Highly recommended. – Mansoor Niaz, Universidad de Oriente, Venezuela

> This volume provides an extremely valuable set of insights into educational issues related to the history and philosophy of science. – Michael J Reiss, University College London, UK

**Section I: Science, Culture, And Education**



**Section II: Teaching and Learning Science**



**Section III: Curriculum Development and Justification**

**Section IV: Indoctrination and Science Education**

11. Lena Hansson, Science Education, Indoctrination, and the Hidden Curriculum

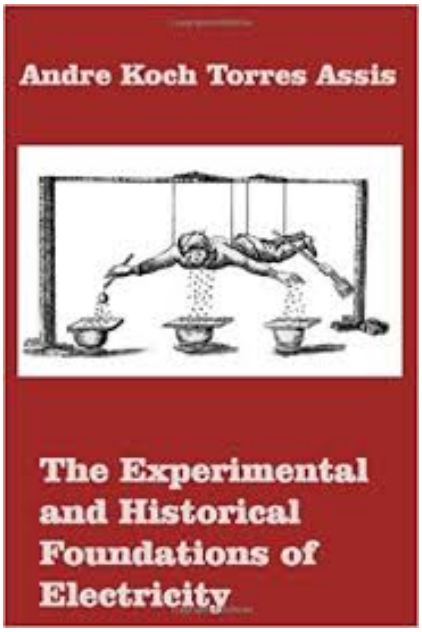
12. Paul A. Wagner, Warranted Indoctrination in Science Education

More information at: http://www.springer.com/gp/book/9783319626147

Hardcover 110 €; eBook 92 €; MyCopy Printed eBook for €/$ 25

## Experimental and Historical Foundations of Electricity: Downloadable Book

The book describes the main experiments and discoveries in the history of electricity. It begins with the amber effect, which is analogous to the usual experiment of attracting small pieces of paper with a plastic ruler rubbed in hair.




This work explains how to build several instruments: versorium, electric pendulum, electroscope and charge collectors. We discuss electric attraction and repulsion, positive and negative charges, and the ACR mechanism (attraction, communication of electricity, and repulsion). The book analyzes the concepts of conductors and insulators, together with the main differences in the behaviours of these two kinds of substances.

Historical aspects are presented, together with relevant quotations related to electricity from some of the main early scientists like Gilbert, Guericke, Du Fay, Aepinus, Newton, Kelvin, etc. All experiments are clearly de-

scribed and performed with simple and cheap materials, easily accessible. These experiments lead to clear concepts, definitions, and laws describing these phenomena.

The book presents a detailed analysis of the work of Stephen Gray (1666-1736), the great British scientist who discovered conductors and insulators, together with some of their main properties. A large bibliography is included at the end of the work.

Videos of experiments inspired by this book have been made in Italian by Pietro Cerreta of the organization ScienzaViva (available here) and in German by Derk Frerichs and Stephan Pfeiler (available here).

The book may be downloaded in English here. The printed book in English, Portuguese, Russian and Italian can be ordered through Amazon and AIF, respectively.

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## European Society for the History of Science Biennial Conference and British Society for the History of Science Annual Meeting, University College, London, 14-17 September 2018

The organising committee of ESHS 2018 invite proposals for individual papers to be presented at the conference. The organisers will aim to arrange submissions into coherent strands. In selecting papers for the conference, the organisers will give preference to those that address, in some way, the conference theme of 'Unity and

Disunity'. This can be interpreted very broadly, to address, amongst other topics, unity and disunity within and across diverse sciences, nations, periods, and historiographies; unity and disunity as ideals and realities; and unity and disunity as characterizing relations between the sciences and politics, technology, economics, and the arts. Submissions, including an abstract no longer than 300 words in either English of French, should be made, via the conference website http://eshs2018.uk, by 23.59 GMT on 28 February 2018.

## 4th Latin American Conference of the International History, Philosophy and Science Teaching Group (IHPST-LA), September 3 to 5, 2018, Federal University of ABC, UFABC, Santo André, Brazil

After 8 years from the 1st Latin American Conference, in Maresias (SP), and 3 years from the 13th Biennial Conference of the IHPST, in Rio de Janeiro (RJ), Brazil will host again a group meeting. In three days of intense discussion, we seek to promote a wide debate among historians, educators, teachers and others on the relation between history, philosophy, sociology and science teaching.

There will be three kinds of submission of proposal: oral communication, poster and thematic symposia. Proposals may be submitted in Portuguese, Spanish or English.

Submission of proposals (all categories): from February 19 to March 30
Early registration deadline: June 3

If you have any doubts and suggestions, send an e-mail to ihpstla2018@gmail.com

Complete version of CFP: http://www.brenoam.com/ihpstla-2018-en.

# Opinion Page

## On Learning How to Teach the Black Death

Monica H. Green, History Department, Arizona State University

Monica H. Green is Professor of History at Arizona State University. She was the winner of the Joseph H. Hazen Education Prize in 2014, awarded by the History of Science Society in recognition of outstanding contributions to the teaching of history of science; and, in 2018, of the Medieval Academy of America/CARA Award for Excellence in Teaching.

### The Gifts of the Magi

Throughout my career, I have considered myself a specialist in the history of medieval European medicine. I trained in the History of Science program at Princeton University, taking my doctorate in 1985, and then I did a postdoc at the University of North Carolina at Chapel Hill with the renowned expert on medicine in medieval Spain and France, Michael R. McVaugh. But until 2012, I never taught a course on the Black Death, the plague pandemic that struck the Mediterranean and Europe in the late 1340s, and which is considered the largest single disease mortality event in human history. How was it that I could avoid such a massive elephant in the room of my discipline?

The answer was simple: I had no interest in teaching a topic that seem bedeviled, on the one hand, by endless, insoluable debates about its cause and, on the other, by a rich but seemingly static body of primary sources that were endlessly trotted out as "set pieces" in the Black Death story: Gabriele de Mussis's (non-eyewitness) account of Mongols of the Golden Horde throwing disease-ridden bodies over

the walls of Caffa; Boccaccio's depictions of hysteria at the beginning of the Decameron; caricatures of the helplessness (or downright incompetence) of learned European physicians in the face of this unknown disease. I didn't do the history of infectious diseases in my own work (my research for many years was on various aspects of the intellectual and social history of European medicine, a field that still commands much of my attention), so it all seemed too much trouble to try to make any pedagogical intervention aside from giving rudimentary summaries of the pandemic in my other lecture courses.

What turned my reluctance about teaching the Black Death around was the slow realization, over the course of several years, that microbiologists' at-first-tentative attempts to intervene in debates about the Black Death's cause had finally struck gold. Historians and demographers had certainly been right, starting in the 1970s, to ask the question of what caused this sudden mortality of millions of people in the middle of the 14th century. The problem was that they were digging themselves into a hole. Working in the period after the shift to a basic germ theory of infectious disease–the idea that infectious diseases are caused by microscopic foreign agents that come into our bodies–they shifted historiography of the Black Death to focus on a debate about microbes. But our historical evidence (chronicles, tax records, wills, medical treatises, sermons, etc.) was never going to solve this question for one fundamental reason: nobody prior to the modern period saw microbes. Historians, in other words, were never going to be able to answer the question they had posed.

What has happened in the past two decades could not have been predicted, and so has been all the more extraordinary to watch. Microbiologists took up the gauntlet that the historians threw down, not simply solving the question of what caused the Black Death (spoiler: it was indeed *Yersinia pestis*, as had been suspected since the 19th century), but also laying the foundations for what is now a minor subdiscipline within the larger field of genomic microbiology: the study of ancient pathogens and the evolution of infectious disease organisms. I was not involved in any of these researches, and only began to hear about them around 2005.

Curious to know whether or not I should incorporate this new work into my teach-

ing, I persuaded a colleague to join me in applying to run a U.S. National Endowment for the Humanities (NEH) Summer Seminar that would allow us to explore this issue (and other new historiographical trends in medieval medical history) along with other teachers in the field. It ended up taking three years of submissions before the NEH was finally persuaded that humanists could engage profitably with the sciences and ask the major "So what?" questions of how disciplines might work in unison (or at least in parallel) to address historical questions of major consequence. During the first seminar, in 2009, I was still skeptical that a scientific approach (beyond paleopathology, which is a different method[1]) had anything meaningful to offer historians. By the 2012 iteration of the Seminar, I was convinced that paleogenetics was a method of real import, and finally dared to launch an undergraduate course on the Black Death. By 2014, in putting together a collection of published essays, I had finally figured out an answer to the "So what?" question.

The answer is that the "new genetics" of plague offers the historian three important gifts, all of which allow us now to begin to do historical epidemiology in a way that mirrors what modern epidemiologists can and must do in tracking disease spread. The first gift–and the one for which the paleogeneticists received international praise–was in decisively determining the pathogen involved in the Black Death. One particular study in 2011 got the most attention, but the process of developing the methods and protocols for aDNA ("ancient DNA") work had developed over a number of years, and involved the work of a number of labs. *Yersinia pestis* (referred to in earlier science and historiography as *Pasteurella pestis*) was confirmed as the causative organism.

The second gift was that, in successfully sequencing the bacterium's whole genome from samples taken from a well-documented Black Death burial site in London

[1] Paleopathology, which largely relies on ocular examination of lesions in the skeleton and teeth of human remains, had established, at least from the 1950s, that there were regular criteria that could be used to determine the presence of leprosy infections, one of the other main infectious diseases of medieval Eurasia. The Seminar focused on that work as well. Since 2013, paleogenetics has also succeeded in reconstructing the genome of historic samples of *Mycobacterium leprae*, the causative organism of one form of leprosy. See Benjak *et al.* 2018 and Honap *et al.* 2018 for the most recent work on M. leprae's evolutionary history.

(this was the signal achievement of the 2011 study), researchers were able to say with confidence how–and importantly, how little–the Black Death genome differed from *Y. pestis* as it is documented in the world today. Over the course of the last 700 years, *Y. pestis* hasn't changed that much. Only a few dozen single nucleotide polymorphisms (SNPs) separate the 14th-century organism from strains that persist in the world today. This is significant for historians because it was no longer permissible to hypothesize that the huge mortality of the 14th century was caused because the strain involved was significantly more virulent than strains that caused the Third (modern) Pandemic, or that have been sequenced in modern labs today. Causes for the almost inconceivable medieval mortality would need to be sought elsewhere. This finding also meant that modern laboratory and field studies of *Y. pestis* could be used analogically to investigate historical aspects of the disease for which we were unlikely to find written evidence, e.g., the role of specific flea vectors or mammalian hosts or ambient conditions that might affect plague outbreaks. Since plague is considered a Class A pathogen in terms of its bioterrorism potential (the classification refers to pathogens that can be easily transmitted and have the potential to cause high mortality), *Y. pestis* has and continues to elicit a good deal of laboratory research. In other words, this is a disease we can actually study in great detail.

The third gift is a result of what made the aDNA work possible, that is, extensive study of the genomes of modern *Y. pestis* strains, which have allowed the organism's evolutionary history to be revealed. Every new *Y. pestis* genome that is reconstructed from historical remains can be fitted into a larger narrative of the organism's history that has been constructed from modern samples, thus increasing the robustness of the narrative and fine-tuning our understanding of the organism's (and hence, the disease's) history. For example, in 2016, a genome was sequenced from remains buried within one of the basilicas of the Spanish port town of Barcelona. Although the carbon-dating of the remains produced only a rough chronological estimate of "1300-1420," we know from documentary accounts that plague arrived in Barcelona by May of 1348. Hence, it is not in the least surprising to find that the genome from Barcelona matches, down to the last distinctive SNP, the genome sequenced from the Black Death cemetery in London, a burial ground created in

late 1348 or very early 1349, and closed in 1350 when the epidemic had passed. Not every new genome sequenced fits the tidy narratives that geneticists would like to propose, but collectively each one tells us part of a unified story of plague, encompassing plague everywhere from Spain to China to Arizona (where I live), at every point from the Bronze Age (whence we now have our earliest complete sequences) up to the outbreak of plague in Madagascar in 2017.

As a result of these three "gifts" that molecular microbiologists have given historians, there are, I would argue, four new "truths" about the Black Death that should now be taught as basic elements of our narratives, whether in middle school when teaching about the larger trajectories of pre-modern history, in college survey classes that cover pre-modern Afro-Eurasia or global history, or in specialized courses either about the history of plague or the history of infectious diseases generally. I lay these new truths out below, followed by some observations about where the next "disruptions" of our common understanding are likely to take place. I conclude with some brief suggestions about how to organize teaching notes on the Black Death for those who have to cover it quickly in the context of other survey courses.

**Truth #1: Genetics Has Given Us a Unified Evolutionary History of Plague Throughout the World**

As the above account will have made clear, the "new genetics" is what has made teaching the Black Death possible for me. But, more than that, it has made a whole new mode of thinking about the disease possible, one that connects plague in any part of the world, at any time, with plague everywhere else in the world. No longer do we have to wonder how long plague has been present in the Americas. (Answer: since about 1900.) No longer do we have to wonder how the strains of plague in East Africa relate to those in South Africa. (Answer: they belong to completely different radiations of plague.) This story rivals any of the great commodity stories that we have seen in global history of late (like those of cotton, silver, or sugar), in that it involves a single organism, one that is still so like the ancestor it shares

with another, comparatively harmless pathogen, as to be considered "clonal." Even before the whole genome of *Yersinia pestis* was sequenced in 2001, microbiologists had begun to infer the rough outlines of the bacterium's genetic history. Once a few additional sequences were available, it became possible to compare whole genomes with partial sequences collected from around the world. In 2004, it was argued that the concentration of evolutionarily ancestral strains of *Y. pestis* in western China suggested that that might be the organism's ancestral home. By 2010, a whole global narrative had been constructed of *Y. pestis*'s dissemination.

Separately, in another field of the expanding genetics universe, other microbiologists were refining techniques to collect, reconstruct, and identify fragments of genetic material from the remains of victims of known plague outbreaks. This is the aDNA ("ancient DNA") I briefly recounted above. Although *Y. pestis* often enters its mammalian host through the bite of an ectoparasite (usually fleas, but also ticks and possibly lice), and thereby enters into the lymph system (causing the distinctive buboes of bubonic plague in lymph nodes of the groin, armpits, or neck), by the time it kills its host it will have passed into the bloodstream and therefore move throughout the entire body. The idea occurred to early researchers that remnants of a blood-borne pathogen might remain in the teeth of victims: while blood comes into the teeth to feed the soft inner pulp (and so brings any blood-borne organisms with it), the hard external enamel offers a sterile casing that might preserve genetic material for considerable periods of time.

After much trial and error (nicely recounted in an essay by Lester Little in 2011), the field finally yielded results proving the presence of *Y. pestis* in historical remains from pre-modern Europe. Initially, those reconstructed samples were only partial genomes: enough to confirm that *Y. pestis* was present and to begin to distinguish strain from strain, but not enough to fully characterize it genetically. In 2011, however, came the breakthrough study that announced a complete sequencing of *Y. pestis* from a well-dated Black Death cemetery in London. This study, produced by research groups working at Tübingen in Germany and McMaster University in Canada, was published with great hubbub in the popular press, including an editorial–not simply a Science-page write-up, but an editorial–in the New York

Times.

In 2013, another international team of researchers took the aDNA genomes sequenced by the Tübingen/McMaster group and plotted them onto a revised phylogenetic tree, which drew on a total of 133 whole genome sequences (most of them newly sequenced for this project). Every genomics study on *Yersinia pestis* that has been published since then, whether it is reporting on modern samples, such as in Uganda or Madagascar or Kyrgyzstan, or on aDNA, such as studies on the newly discovered Bronze Age plague strains in 2015 and 2017, the Justinianic Plague in 6th-century Bavaria, or sequences from medieval Barcelona and Bolgar City, or early modern Germany, or 18th-century France, has produced results that can fitted into the overall phylogenetic tree first proposed, in rough outline, in 2004, and given its present 5-branch structure in a study by Cui *et al.* in 2013.

Below (fig. 1) is my own marked-up version of the Cui *et al.* 2013 tree, which shows the major plague events of history. And there, at the center of it all, is the Black Death and its immediate aftermath, the *pestis secunda* (1359-1363), as documented from the two genomes (the maroon triangles) sequenced in 2011 from London.[2] (The Justinianic Plague, indicated by the overlain blue box, and Bronze Age genomes, not shown at all, were sequenced after the study by Cui and colleagues was published.) Right before the Black Death, at a date estimated to have fallen at some point between 1142 and 1339, *Y. pestis* diverged into four new branches. That event–which technically is called a "polytomy" (manifold divergence) but was dubbed more evocatively, by Cui and colleagues, the "Big Bang"–created modern strains of *Y. pestis* that persist to this day. We can say now, for example, that the Black Death strain that reached western Europe in 1347-48 was indeed an early progenitor for what would, 600 years later, become the source of the Third Pandemic in Hong Kong. In calling these genetics findings a "gift" to historians, there-

[2]The 2011 study by Bos *et al*. actually had an error. A sample (labelled 6330) that they identified as coming from the East Smithfield Black Death Cemetery, a burial ground which could be precisely dated to 1348/49-1350, in fact came from a later burial site, associated with the second major wave of plague, the *pestis secunda* (1359-63, though starting in London, it seems, in 1361). See Green and Schmid 2016 for more details about the significance of this finding for *Y. pestis* history; for an example of the *pestis secunda*'s differing demographic impact in England vis-à-vis the earlier Black Death, see DeWitte and Kowaleski 2017.

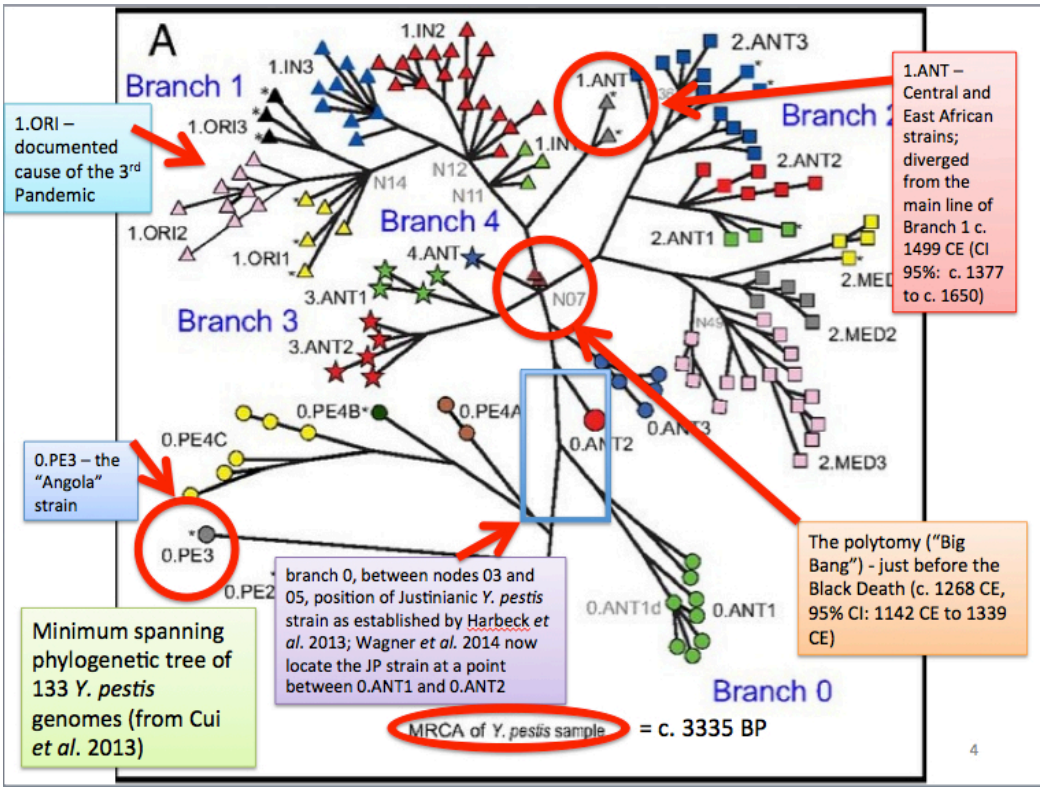


Figure 1: Minimum spanning phylogenetic tree of 133 *Y. pestis* genomes, with major historical events marked. From Y. Cui *et al.* 2013, fig. 1A, with additions by M.H. Green.

fore, I do mean precisely that: because of methods they brilliantly developed to ask questions in biology, the geneticists were able to create a coherent biological story of plague that no amount of scouring through textual sources was ever going to give text-reliant historians. And they have shown, decisively, that the most important chapter of plague's history falls in the Middle Ages.

### Truth #2: The Black Death Was Likely Even More Devastating Than We Have Ever Imagined

We will never have reliable estimates on the mortality levels caused by plague in the 14th century, for the simple reason that no mechanisms of systematically recording deaths existed at that time. Various kinds of proxy evidence are being investigated

(see next section), and it continues to be important to economic history and social history to wrestle with the severity of impact. Here, however, my emphasis is not on our (in)ability to count, but on our inability to even imagine the extent of devastation in some places. On this point, we need to reckon with two different issues: (1) the possible underestimation of the extent of mortality within those areas we have always included in our geography of the Black Death; and (2) the underestimation of the geographic extent of plague's spread in the late medieval and early modern world that had previously been beyond our ken. I will return to the first issue in the next section. On the latter one, we don't have even rough estimates of mortality levels, since we have barely perceived that there were mortality events we should be looking for.

Look again at the phylogenetic tree above. In the upper left quadrant is Branch 1, one of the four new distinct *Y. pestis* lineages created by the "Big Bang." Since Cui *et al.* 2013 was published, geneticists at Munich on the one hand, and at Jena and Tübingen, on the other, have established that a distinct new branch of *Y. pestis* caused plague outbreaks in Europe from the 14th to 18th centuries. Of the two 14th-century genomes shown on the tree (the two maroon triangles near the center), the earlier strain spawned "offspring" in Europe documented at Manching-Pichl (14th century) and Brandenburg (17th century), Ellwangen (15th-16th century), and Marseille (18th century). I now refer to this lineage as **Branch 1A**. If we can assume that all plague epidemics, save one, in western Europe between 1347 and 1722 (the end of the last Marseille plague) were caused by this strain–which seems now to be utterly extinct–then we can begin to assess how much plague devastation is nowhere indicated by the living strains that now make up the biological narrative we have for *Y. pestis*. To put it another way, if we didn't have our written record testifying to the millions of plague deaths in outbreaks in countless European communities between the 14th and 18th centuries, we would have no trace that this devastation had happened, simply because, in the end, the organism burned itself out, exhausting its supply of hosts.

If we turn to areas without written records, therefore, such as sub-Saharan Africa[3],

[3] A collection of essays, edited by Gérard Chouin, exploring the question of plague's possible presence in sub-Saharan West Africa, and in East Africa, in the late medieval and early modern

or areas where the kinds of sources we have used to reconstruct mortality levels in, say, England or the Low Countries, such as virtually unbroken series of tax rolls and other financial or legal records, don't exist, such as Egypt and other areas of the Middle East[4], how would we know whether or not comparable mortality events had occurred? Now look once again at the phylogenetic tree. Those branches (and subbranches) of plague that have survived in **Branch 1B** (all the rest of Branch 1 shown on the tree) likely did so primarily by subsisting through sequences of rodent hosts, probably wild ones. Yet we know that, at some point, some of those strains must have passed through human populations. Humans and their technologies of long-distance transportation, it seems, are the chief reason *Y. pestis* has been able to achieve the transcontinental (and intercontinental) spread it has enjoyed in its last 5000 years of existence. Thus, for every living strain of plague, we need to ask how many minor extinct strains burned out in the bodies of human victims.

Now look one last time at the phylogenetic tree. **Branches 3 and 4**, creations of the same late medieval polytomy as Branch 1, have only been documented in a handful of samples in western China, Mongolia, and southern Siberia. We do not know at the moment whether their historical impact may have extended beyond that narrow region. But look at **Branch 2** (which is made up of two twin subbranches, 2.MED and 2.ANT). It has been every bit as prolific as Branch 1 in creating surviving strains. Although its geographic footprint is not so wide as Branch 1's–it has never been documented in the Americas, for example, and only on the very northern edge of Africa–its reach across the breadth of eastern and central Eurasia is astounding. We have no aDNA yet to tell us the backstory of Branch 2. Whether it will end up explaining the many epidemics reported in 14th-century China, and later, remains to be determined; at the moment, we have no descriptive accounts of sufficient detail to postulate plague as the cause. But if the story of the extinct Branch 1A is any guide, the phylogenetic evidence of Branch 2's prolifera-

world, is forthcoming from the online journal Afriques.

[4]See Stuart Borsch and Tarek Sabraa, "Rural Refugees: The Forgotten Victims of the Black Death," part of a special issue, "Le retour de la peste: Nouvelles recherches sur les épidémies en Europe et en Méditerranée, XIVe-XIXe siècles," Annales de Démographie Historique 134, no. 2 (2017).

tion everywhere from Mongolia to India, from China's far eastern province of Jilin to as far west as Libya, will likely tell us a story of extraordinary human suffering[5].

Truth #3: Sometimes Silence is the Only Evidence We Will Find

Everybody dies, but it is actually rare in human history for many thousands, or even millions, of people to die all within a short period of time. Dealing with sudden and widespread death was one of the unique challenges in plague epidemics, something we see both in the Justinianic Plague in the 6th century, and in acute episodes of the Second Plague Pandemic. Mass graves are being increasingly investigated as unique witnesses of demographic catastrophe. Mass burials due to epidemic mortality must, of course, be carefully differentiated from battle sites and a few other situations (like volcanic eruptions or tsunamis) that might cause mass death. But that differentiation is usually easy to do, leaving archaeologists with the possibility of assessing various aspects of plague's impact, such as the prior health status of the individuals killed by the disease or the relative health of individuals who survived the epidemic. We also, chillingly, are now able to document the reality of the assaults on Jewish communities that started with plague's first arrival on the European mainland in the spring of 1348.

Sometimes, however, there are no remains at all. It is a commonplace of plague narratives, both in the Islamicate world and Christian Europe, to measure the level of catastrophe simply by saying that there weren't enough people left living to bury the dead. Silence is being recognized as a feature unto itself now, an indication of catastrophic depopulation. Evidence of silence may seem an oxymoron, but in fact the edges of such absence are often visible. Bureaucratic records, for example, that would ordinarily, in their very monotony, record the cycles of living and dying, might simply cease, because the clerks who would normally prepare them have died, or the courts that adjudicated them have stopped functioning. Archaeologists

[5] In her superb monograph, *Plague and Empire in the Early Modern Mediterranean World: The Ottoman Experience, 1347-1600* (Cambridge: Cambridge University Press, 2015), Nükhet Varlık documents that the Ottoman Empire went from a pattern of infrequent outbreaks in the 14th and 15th centuries, to a pattern of almost annual outbreaks in the 16th century. Whether or not that shift was accompanied by a change in the *Y. pestis* strains involved cannot yet be determined. **Branch 1B** does have some points of overlap in its geography with **Branch 2**; both, for example, are now found in Qinghai and Yunnan Provinces in China.

are particularly adept at determining the diminution of human activity or even its total disappearance. Agricultural lands become overgrown and go "wild" again, something that can now be studied via pollen deposits; architectural remains can show a cessation of basic maintenance to allow habitation, accompanied by the absence of any new building; villages can "disappear" into the forest. In perhaps the most innovative technique yet devised, archaeologist Carenza Lewis has used crowd-sourced archaeology to assess the changes in human habitation of different areas of eastern England in the period after the Black Death. Ceramic pottery is an excellent record of human habitation because it's very commonly used by most social classes; it often is produced according to the fashion of the times, which makes it roughly datable; it usually becomes useless when it's broken because (unlike, say, metals which can be melted down) it cannot readily be recycled; and it tends to last a very long time once abandoned. Lewis had the idea to do lots of small test digs to see what areas seemed to continue to produce signs of activity, vs. areas which, although previously active, were later "quiet." Her results were stunning.

Another kind of silence is iconographic silence. We, who live now in an image-saturated world, accustomed to over a century and a half of photographic witnessing of events, and over 600 years of print media, find it hard to grasp the fact that only a handful of images depict plague-related scenes in the first half century of Europe's new encounter with the disease. And none of them depict diseased bodies. The first surviving images of the distinctive buboes of bubonic plague don't appear until the 15th century, at least half a century after the disease struck Europe. In other parts of the world, we have no images at all until centuries later. The modern proliferation in both scholarly publications and on the Internet of misconstrued images masquerading as "plague" has recently been revealed for the error it is. As with the pottery shards and missing bureaucratic records, sometimes we have to accept that what we're looking for simply isn't there.

**Truth #4: The Black Death Never Ended**

The mid-fourteenth century "pestilence of mortality" (as many Latin documents termed the Black Death) or "the universal plague" (as chroniclers writing in Arabic called it) did eventually pass. The crises of mass deaths abated, cemeteries were closed, and property (once courts began to function again) was divided up among the survivors. As noted, plague is not a human disease and cannot be sustained very long via human-to-human transmission. But the organism, *Yersinia pestis*, persisted. Textbooks will often list a series of outbreaks that followed the 1346-53 pandemics, and there is excellent monographic work on particularly large plague outbreaks in the early modern era, such as at Seville in the 16th century, or Italy and England in the 17th.[6] There is more explicit discussion now of the Second Plague Pandemic, that correctly sees the Black Death not as an isolated phenomenon but the beginning of a long shared trauma, tied closely to the period of the Little Ice Age and an age where many more diseases besides plague alone afflicted the populations of both Old World and New. But we have reckoned too little with what these subsequent, lesser "pandemic" outbreaks actually meant as disease phenomena. The process of *focalization* has now become a research question in its own right, and it is central to figuring out how the long sequence of plague outbreaks that characterized much of the Old World between the later 14th and 19th centuries became established.

Between 80 to 90% of plague strains identified in the modern world took their origin after the great late medieval polytomy. Looked at another way, all those modern strains are evidence of how many locales proved continually hospitable to plague after the Black Death. Plague foci (plural of the Latin, *focus*) have been well studied in areas where plague persists in the modern world, such as Russia, China, and, since the early 1900s, much of the American West. Such areas may be fairly small, but as long as *Y. pestis* can keep moving from flea to animal host to flea to host, it will persist.[7] Virtually all of these reservoirs would have had the potential to cause

[6] The essay reviews of Alfani and Murphy 2017, and Varlık 2017 provide excellent surveys of this literature.

[7] Other possible stages in *Y. pestis* persistance have been postulated, such as a possible telluric (soil) phase or absorption by amoebas. These have not yet been proven, however, to be normal

new human outbreaks, provided that environmental circumstances facilitated the organism's propagation and, crucially, its transportation to areas of human habitation. Currently, we have no reasonable idea how many times that process may have occurred. Since many strains may have proliferated for a brief time and then burned out, we must assume that plague's late medieval and early modern footprint was much more extensive than we can yet document. The long history of plague in the Ottoman Empire has now been written, and we have good accounts for parts of the Low Countries, Russia, and the Baltic Region. Nothing comparable yet exists for the similar stories that must yet be written for North Africa, India, and China. Collectively, however, the new genetics has taught us that what is now regularly called the Second Plague Pandemic needs to be seen as part of the Black Death story, a sequel that, in reality, extends to the present day.[8]

### Going Forward: The Black Death Must Be Taught as a Developing Field

I am currently writing a textbook on the Black Death. As the present account will have indicated, my objective is to create a new narrative of the Black Death as an epidemiological phenomenon: not just a single event but the beginning of a long "disease regime" that characterized not only Europe, but also the Ottoman Empire, and much of eastern Eurasia for many centuries. The question has been raised, from archaeological data, whether the Black Death also struck sub-Saharan West Africa, whereas genetics makes it clear that in East Africa, the plague regime initiated by the Black Death and extending, apparently, the entire length of the Nile all the way to the Great Lakes, persists to the present day. And it was because the particularly adept Branch 1B lineage migrated out of its late medieval focus (southern Russia? the western Caucasus?) and reached Yunnan Province (in the 17th century?) that a new proliferation of plague became possible at the end of the 19th century. Reaching the major shipping port of Hong Kong and exploiting now the

elements of the *Y. pestis* life cycle.

[8] I have not, in this account, given attention to the questions that have long animated most Black Death historiography, to wit, the economic impact of the massive late medieval mortality. The work of Guido Alfani has been particularly important in connecting the late medieval and early modern narratives in demography and economics; Alfani 2017 provides a very good survey of the literature. On larger global impacts of Europe's new disease regime, see Belich 2016.

new, faster technology of the steamship, plague was now carried to Madagascar, India (again), South Africa, Australia, and the Americas, as well as revisiting its old haunts in Europe and the Mediterranean.

This evolutionary story has now shown a robustness in incorporating new findings that suggests it will endure. Our phylogenetic tree of *Y. pestis* will get "bushier" with every new aDNA sequence or new subbranch found in hitherto unsampled locations. But its general structure will likely hold. However, while that global, evolutionary narrative of plague's history is likely to remain intact, many particular elements of the story will undoubtedly change in the coming years as new research in a variety of fields is explored. A wise teaching program, therefore, would be to develop command over a few key issues as modules, which can be individually updated from time to time without having to revise the entire unit. (See the teaching plans below.) Here are some topics that are most likely to see major revision in the immediate future.

***The Black Death Map***. The greatest need in the field right now is cartographic. Verbal reports of plague have been the foundation on which maps of the Black Death have been drawn for decades. Those demand scrutiny themselves, of course, but they will continue to have their utility. Additionally, maps that show where *Yersinia pestis* has been recovered from human remains–either from biochemical assays, partial genomic studies, or whole genome sequencing–bring a cold reality. (Instructors will need to assess the appropriateness of using images of mass graves in class, according to the maturity of the students and community norms.)

However, with the transition from partial genome studies to whole genome studies, as we have seen, we are in the position to *track* specific strains of plague across space and time. Currently, we have no adequate maps to capture the basic geography of the late medieval polytomy and the initial spread of plague in the 13th and 14th centuries. The biggest absence is anything reflecting current understandings of the Black Death's devastation or plague's creation of new foci across Eurasia and into Africa. (An important exception is the maps created for a 2015 study of plague in the Ottoman world.) Currently available maps can be used in the classroom, but only if they are immediately critiqued as not capturing the narrative as we presently

understand it. For example, the map below (fig. 2), included in an open-access world history curriculum for high school, tries to capture William McNeill's notion that plague spread all the way from southeastern China to the Crimea in the space of just over a decade in the 1330s and 1340s. Our current understanding of *Y. pestis* genetics and 14th-century history would make such a transmission scenario impossible. The strains involved in the two areas would likely have had no direct relationship, other than both being the result of centrifugal spread out of a central Eurasian focus; pan-Eurasian transmission does not accord with any narrative accounts we have either of plague's spread or of commercial activities in the period. Similarly, maps showing plague striking western Europe in "waves" have been shown to be misleading for a variety of reasons, and not simply because the underlying research has, in some cases, failed to recognize the extent of plague's effects on such areas as Bohemia and the Low Countries. A new Black Death map, conceived on a GIS basis and allowing for dynamic overlays plotting the "routes" of different strains of *Y. pestis*, would be a boon in the classroom.

***The Mechanism of Spread.*** Related to the issue of the timing and routes of plague's spread in the 13th and 14th centuries (and thereafter) is the perennial conundrum of the mechanism by which plague spread. The idea of "rats on the march" is, of course, ridiculous but the fact of the matter is that we have no alternatives that can plausibly explain plague's exceptionally efficient transmission in pandemic circumstances. Was it the grain trade? Was it the textile trade? Was it lice? Have we underestimated how much pneumonic (direct person-to-person) transmission may have played a role? Given how much variation there is in plague transmission historically (maritime vs. overland, summer but sometimes winter, high elevations and low), it is unlikely that any single mechanism will explain everything. But efforts to address this critical question will continue since, as noted above, genetics has already ruled out any significant difference in the causal organism that could explain the extraordinarily high mortality, and extraordinary geographical reach, of the 14th-century pandemic.

***The Role of the Mongols.*** Now that genetics has tied together the genesis of Branches 1-4 of the late medieval *Y. pestis* phylogeny, we cannot help but see the larger con-

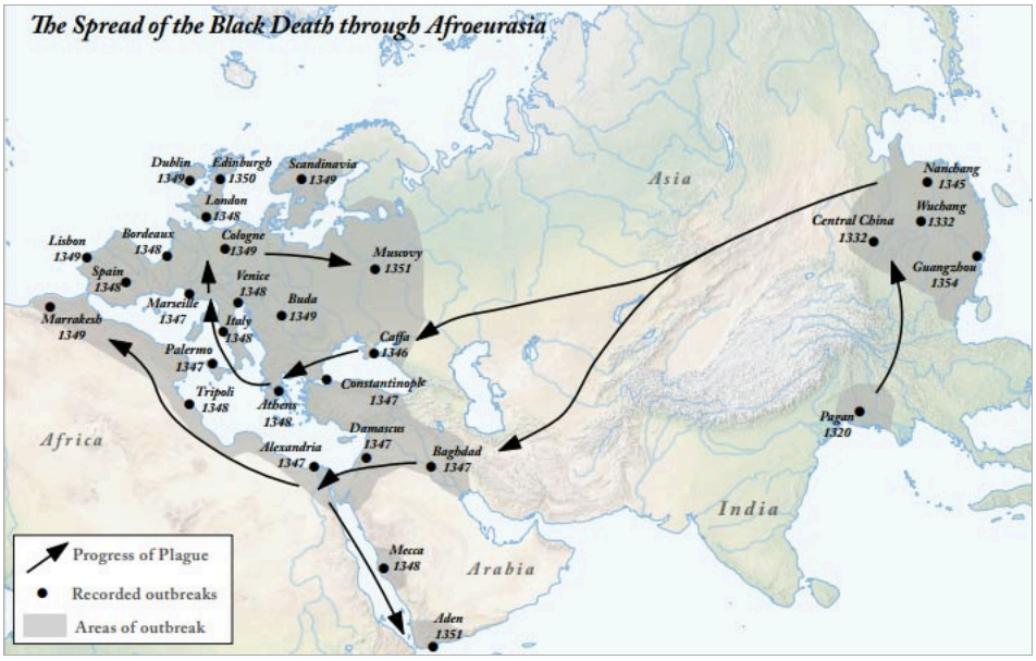


Figure 2: A map of the Black Death's alleged routes across Eurasia, drawn to reflect the theories of William McNeill from 1979; distributed for an open-access high school World History teaching platform, *History For Us All*, and accessed 02/07/2018. This accords not at all with current genetic understandings of *Y. pestis*'s evolutionary development in the 13th and 14th centuries.

text of what unites much of Eurasia together in this period. And that, of course, is the fact that the largest pandemic in human history occurred at exactly the same time as the largest land empire in human history. Yet the Black Death has figured hardly at all in Mongol historiography (which has actually been a thriving field in recent years), despite the obvious coincidence in the timing of the polytomy and the rise (and fall) of the Mongol Empire between 1205 and ca. 1368. The new genetics, moreover, has now established the importance of the obvious geographical overlaps between where the strains leading up to the polytomy are currently found (far western China and Kyrgyzstan) and where the key areas of Mongol activity were. There remains, however, the absence of testimony in Mongol sources to plague, either as the cause of individual deaths or as the cause of major epidemics. But that may be a function of two factors: first, the basic character of plague, which is not a human disease, meaning that unless there are human outbreaks on-going, it is unlikely to elicit notice in written records; and second, conventions in medical thought and writing, which don't necessarily emphasize superficial symptom description in diagnostics or explanation. Fortunately, there is new work being done that casts a fresh eye on written sources from areas under Mongol rule and it is beginning to suggest that, as noted above, the apparent silence of our sources has been covering over events of significant magnitude. Multidisciplinary teams will be needed both to sift through the extraordinarily diverse records of the Mongol Empire (which are found in over two dozen different languages) and to reconstruct a bioarchaeological record of a disease that managed to traverse 1000s of kilometers of open steppe and desert with nary a trace other than microbial descendants that inhabit that terrain today.

### A One-Week/One-Day Curriculum for Teaching the Black Death

Most instructors will not be able to devote a whole semester to plague as a phenomenon in global history. The following curriculum allows incorporation of a mini-narrative of plague as a historical force, with the explicit intent of raising questions for the student about how to think about humankind's relationship with infectious disease and why mass mortality needs to be assessed for both its demo-

graphic and social effects. The climate issues have been minimized, not because the coincidence of plague pandemics with major cooling episodes is not well documented now (that is, the onset of the Late Antique Little Ice Age, including major volcanic activity in 536 and 541, with respect to the Justinianic Plague, and the "Great Transition" preceding the early modern Little Ice Age, with respect to the Black Death and the Second Plague Pandemic), but only because the causal links with plague's biology have yet to be convincingly explained.[9]

Some instructors, of course, need to compress their coverage of the Black Death into a single day, or less. For them, I've indicated the main take-home messages that any student of history should now understand about this epidemiological catastrophe. There are a number of syllabi publicly available which have extensive bibliography. My syllabus and extended reading list for my own Black Death course are already available online, and can be used to find both primary and secondary sources. (For K-12 teachers, the Black Death section of this teaching guide is very handy.) Additionally, I teach a course called "Global History of Health" that weaves the narratives of plague in with the origin, dissemination, and globalization stories of seven other "paradigmatic diseases," that is, infectious diseases whose characteristics of zoonotic or environmental origin, proliferation, and containment can serve as models for understanding humans' relations to microorganisms throughout history. An essay situating plague's history within the larger context of disease and climate in medieval Eurasian history can be used to address comparative elements of plague's Eurasian history alongside those of malaria, leprosy, and smallpox.

I haven't made suggestions for specific readings. Because plague studies has become a dynamic new field of study, not only for paleogenomicists, but also for archaeologists (who study mass burial sites and indications of health before and after the Black Death) and traditional document-based historians, any list provided here would need almost immediate supplementation.[10] Rather, I have suggested major

[9] I address these issues in an extended review of Bruce M.S. Campbell, *The Great Transition: Climate, Disease and Society in the Late-Medieval World* (Cambridge: Cambridge University Press, 2016), in *Inference: International Review of Science* (forthcoming).

[10] Keeping up with plague science is a task unto itself. For students who are biologically inclined,

themes and questions that, as I have explained above, should now be part of our basic approach to thinking about plague historically. In linking occasionally to specific studies, I do so because they are good illustrations of my point, not because I am necessarily recommending them for classroom use.

| Topic/theme | One Week (2 class periods) | One Day (1 hour period) |
|---|---|---|
| Precedents (did this ever happen before?) | • Bronze Age plague<br>• Justinianic Plague | [skip] |
| The biology of plague | Epidiological signifiance of bubonic vs. pneumonic presentations | Provide a basic CDC/WHO level summary |
| The geography of plague | Plague as a disease of the Eurasian steppe for the past 5000 years; *Y. pestis*'s ability to focalize in other environments | Introduce, but immediately critique, traditional textbook map |
| • The *Y. pestis* polytomy (the late medieval "Big Bang")<br>• Instigating factors of spread | • Mongol Empire<br>• Changing climate<br>• Was there an eastern counterpart to the Black Death in wester Eurasia? (You're holding the door open here for any new research on China.) | Explain that mechanisms of dispersal in 13th/14th century are still unclear |

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this new overview of plague science will be useful: Rufui Yang and A. Anisimov, eds., *Yersinia pestis: Retrospective and Perspective*, Advances in Experimental Medicine and Biology 918 (Berlin: Springer, 2016). The free biomedical literature bibliographical database, PubMed, captures work published in multiple languages.

| Topic/theme | One Week (2 class periods) | One Day (1 hour period) |
|---|---|---|
| The Western Pandemic<br>• What happened at Caffa?<br>• Spread into the Mediterranean | Assess what's plausible, and what's not, about Gabriele de Mussis's famous account of the siege at Caffa; examine why, geographically, the Caucasus area is becoming a "subject of interest" in the genetics story being told now about plague's history | [ditto] |
| First strikes:<br>• Constantinople<br>• Aleppo<br>• Alexandria<br>• Almeria<br>• Sicily<br>• Florence<br>• London<br>• Norway | Narrative accounts can be analyzed to stress:<br>• contemporaries' understandings of the geography of plague's spread maritime spread<br>• the question of the disease's contagiousness (is it spread from one person to another?) | Traditional primary sources work very well to show mounting anticipation and fear |
| Secondary strikes:<br>• Iceland<br>• West Africa<br>• East African coast | For an abbreviated lecture, these more distant sites of plague activity can only be listed in passing. Nevertheless, it is important to note that research keeps expanding the terrain that plague is likely to have reached in the late medieval period. For Global History courses, these peripheral sites might become the focus. | [skip] |

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| Topic/theme | One Week (2 class periods) | One Day (1 hour period) |
|---|---|---|
| Panic<br>• civil chaos<br>• scapegoating<br>• medical responses | The topic of civil chaos can be approached from a variety of angles, and there is no shortage of primary sources (at least for Europe) to address this question. The question of scapegoating demands great care. Sources are available in English for the worst outrages against Jewish communities in Savoy and the Rhineland. The excavation of a burial ground in Spain serves as powerful testimony to the attacks. A new monograph provides more contextualization of the long-term consequences for Europe's Jewish communities. | Boccaccio still works well for this, though incorporation of an account from at least one other geographic area would offer useful contrast. Ibn al-Wardi, who witnessed plague in Aleppo (and died from it in 1349), is evocative. |
| Silence<br>• missing records<br>• missing people<br>• missing images | This is a field of disaster history that has not been well conceptualized yet. The work of Carenza Lewis, mentioned above, would be an excellent starting point, not least because its concepts are so straightforward and understandable to students, without requiring any background in science or archaeology. | An example from Lewis's research on eastern England will suffice to demonstrate what is meant by abandonment. The misuse of the leprosy images example works very well to teach the problem of using improperly sourced materials. |

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| Topic/theme | One Week (2 class periods) | One Day (1 hour period) |
|---|---|---|
| Reestablishing Order<br>• dealing with burial needs on an unimaginable scale<br>• normalizing property transfers | A few examples will suffice to show the reestablishment of daily routines of social interaction. However, the idea that the Black Death was "good" for societies, in that it raised the standard of living for survivors, needs to be tempered. Those studies are based on single regions. Other areas were permanently crippled by the disaster and never recovered their economic standing. | ditto |
| The *pestis secunda*, 1359-63 | Caused by a new strain of *Y. pestis*; this has been documented in both London and Bergen op Zoom (NL). This likely reflects a new introduction of plague into the Mediterranean basin from the Black Sea, though unlike the Black Death strain, this seems to have burned out in Europe, even though it would go on to spawn the rest of **Branch 1B**. | [skip, other than to indicate that plague did return by 1360 and thereafter, suppressing demographic recovery] |

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| Topic/theme | One Week (2 class periods) | One Day (1 hour period) |
|---|---|---|
| Focalization<br>• The normalization of plague in the context of the Little Ice Age<br>• The normalization of plague control protocols (including quarantine and the *cordon sanitaire*) | Establishing the existence of historical plague foci is a still a major task. It has only been in the past 4 years that the possibility that Europe may have harbored its own foci (rather than reimporting plague repeatedly) has been suggested with plausible evidence (both documentary and genetic). Comparable work has not yet even begun for Africa or central and eastern Eurasia. Nevertheless, both genetics evidence and the documentary record make clear the survival of plague in diverse environments in the early modern period. Future studies will almost certainly underscore the role of the Little Ice Age in facilitating this perduring threat. | Although a few public health (PH) measures were implemented right at the time of the Black Death (usually drawing on pre-plague PH law), most of what we think of as specific plague legislation developed only after multiple experiences with the disease. It is important now to supplement the well-known European cases with data on plague control from the Ottoman Empire. |

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| Topic/theme | One Week (2 class periods) | One Day (1 hour period) |
|---|---|---|
| Early Modern epidemics<br>• Ottoman Empire<br>• Seville, 1582 and 1599-1600<br>• northern India, 1615<br>• Italy, 1630<br>• Seville, 1647–1652<br>• London, 1665<br>• East Africa<br>• Marseille, 1720-22 | Any one of these outbreaks would serve to show how the persistence of rural foci (possibly in highland areas) posed a perpetual threat to neighboring human settlements. These were societies now inured to plague–they knew its signs, its symptoms. But they still had little power to stop an outbreak once it was underway. | The challenge here is to convey that these well known urban outbreaks were symptoms of a plague regime that had established itself across much of Eurasia and North Africa. Some background on the Little Ice Age is necessary. These outbreaks were neither unique nor inexplicable. |

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| Topic/theme | One Week (2 class periods) | One Day (1 hour period) |
|---|---|---|
| Plague's modern history<br>• 3rd Pandemic<br>• global dispersal<br>• modern research | Examples of plague cases in the 21st century can be readily found on Google. It is important, however, to stress that in some cases, especially Madagascar, continuing problems with plague aren't holdovers from pre-modern times, but rather the result of quite modern globalization. Cases showing panic that plague can still elicit are important for conveying the cultural memory that many societies still have. Clips from Soderbergh's *Contagion* (2011) are useful. | Plague was never eradicated. In Europe, the reasons for its disappearance are unclear, though environmental stress may have been a factor, as were almost certainly the control measures that obstructed human-facilitated plague movement and, thus, refocalization. Elsewhere (such as Australia, which never saw focalization of the disease), modern control of rodents, use of antibiotics, and field surveillance systems are what brought plague under control. |

Acknowledgements: As explained above, the NEH Summer Seminars in London in 2009 and 2012 were critical to my ability to explore, out of the limelight of publication, the mounting questions I had about how (if at all) the findings from microbiology and what we now call paleogenetics were to be incorporated into the work we do as historians of the medieval past. But that work was also sustained by a wonderful international community of scholars on MEMED-L, the listserv for medieval medicine I started in 2008. Now grown to over 800 subscribers, it has been a forum in which I could think out loud about how to assess the significance of each new piece of plague research that has come out in the past decade. Kudos, too, to Michelle Ziegler, a biologist by training but a historian at heart, whose blog *Contagions* regularly offers a thoughtful take on plague research, from the perspective of someone who actually knows the biology. Her small list, the Plague Working

Group, was a vital resource and sounding board for several years. Finally, the Institute for Advanced Study (Princeton) offered me the opportunity to engage in some "unobstructed pursuit of useless knowledge" during 2013-14, when I edited the inaugural volume of *The Medieval Globe: Pandemic Disease in the Medieval World: Rethinking the Black Death*, whose open access publication was underwritten by the World History Center at the University of Pittsburgh, through the kind graces of Patrick Manning. This experience allowed me to turn my private queries of the "So what?" question of genetics' contributions to History into a map of potential lines for future inquiry.

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In order to make better educational use of the wide geographical and disciplinary reach of this HPS&ST Note, invitations are extended for readers to contribute opinion or position pieces or suggestions about any aspect of the past, present or future of HPS&ST studies.

Contributions can be sent direct to editor. Ideally, they might be pieces that are already on the web, in which case a few paragraphs introduction, with link to web site can be sent, or else the pieces will be put on the web with a link given in the Note.

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## Recent HPS&ST Related Books

Boudry Maarten, & Pigliucci Massimo (Eds.) (2018) *Science Unlimited? The Challenges of Scientism*. Chicago, IL: UCP

> "All too often in contemporary discourse, we hear about science overstepping its proper limits–about its brazenness, arrogance, and intellectual imperialism. The problem, critics say, is scientism: the privileging of science over all other ways of knowing. Science, they warn,

cannot do or explain everything, no matter what some enthusiasts believe. In Science Unlimited?, noted philosophers of science Maarten Boudry and Massimo Pigliucci gather a diverse group of scientists, science communicators, and philosophers of science to explore the limits of science and this alleged threat of scientism.

"In this wide-ranging collection, contributors ask whether the term scientism in fact (or in belief) captures an interesting and important intellectual stance, and whether it is something that should alarm us. Is scientism a well-developed position about the superiority of science over all other modes of human inquiry? Or is it more a form of excessive confidence, an uncritical attitude of glowing admiration? What, if any, are its dangers? Are fears that science will marginalize the humanities and eradicate the human subject–that it will explain away emotion, free will, consciousness, and the mystery of existence–justified? Does science need to be reined in before it drives out all other disciplines and ways of knowing? Both rigorous and balanced, Science Unlimited? interrogates our use of a term that is now all but ubiquitous in a wide variety of contexts and debates. Bringing together scientists and philosophers, both friends and foes of scientism, it is a conversation long overdue." (From the Publisher)

More information available here.

Darrigol, Olivier (2018) *Atoms, Mechanics, and Probability. Ludwig Boltzmann's Statistico-Mechanical Writings – An Exegesis*. Oxford: OUP. ISBN: 9780198816171

"One of the pillars of modern science, statistical mechanics, owes much to one man, the Austrian physicist Ludwig Boltzmann (1844-1906). As a result of his unusual working and writing styles, his enormous contribution remains little read and poorly understood. The purpose of this book is to make the Boltzmann corpus more accessible to physicists, philosophers, and historians, and so give it new life. The means

are introductory biographical and historical materials, detailed and lucid summaries of every relevant publication, and a final chapter of critical synthesis.

"Special attention is given to Boltzmann's theoretical tool-box and to his patient construction of lofty formal systems even before their full conceptual import could be known. This constructive tendency largely accounts for his lengthy style, for the abundance of new constructions, for the relative vagueness of their object–and for the puzzlement of commentators. This book will help the reader cross the stylistic barrier and see how ingeniously Boltzmann combined atoms, mechanics, and probability to invent new bridges between the micro- and macro-worlds." (From the Publisher)

More information available here.

Deer Richardson, Linda, Goldberg, Benjamin (Ed.) (2018) *Academic Theories of Generation in the Renaissance: The Contemporaries and Successors of Jean Fernel*. Dordrecht: Springer. ISBN: 978-3-319-69334-7

"This volume deals with philosophically grounded theories of animal generation as found in two different traditions: one, deriving primarily from Aristotelian natural philosophy and specifically from his Generation of Animals; and another, deriving from two related medical traditions, the Hippocratic and the Galenic. The book contains a classification and critique of works that touch on the history of embryology and animal generation written before 1980. It also contains translations of key sections of the works on which it is focused. It looks at two different scholarly communities: the physicians (medici) and philosophers (philosophi). (…)The book demonstrates how those working in these two traditions not only shared a common philosophical background in the arts curricula of the universities, but were in constant intercourse with each other. "This book presents a test case of

how scholarly communities differentiate themselves from each other through methods of argument, empirical investigation, and textual interpretations. It is all the more interesting because the two communities under investigation have so much in common and yet, in the end, are distinct in a number of important ways." (From the Publisher)

More information available here.

Dell'Aversana, Paolo (2017) *Neurobiological Background of Exploration Geosciences: New Methods for Data Analysis Based on Cognitive Criteria*. Amsterdam, The Netherlands: Academic Press. ISBN: 9780128104804

"[This book] examines the neurobiological background of earth science disciplines. It presents the fundamental features of the human brain that form the cognitive basis of exploration geophysics and investigates how their analysis can drive the development of new brain-based technologies. Crucial aspects of human cognition include the impulse to explore the environment, the ability of our brain to create mental maps and virtual images of the world, and the human ability to recognize, integrate and save patterns of information in a shared memory.

"Geoscience technology can be made more effective by taking the working neurobiological principles of our brains into account. This book is appropriate for multiple audiences, including neuroscientists, cognitive scientists and geoscientists, presenting both theoretical and experimental results."

More information available here.

Heyes, Cecilia (2018) *Cognitive Gadgets: The Cultural Evolution of Thinking*. Cambridge, MA: Cambridge University Press. ISBN 9780674980150

"How did human minds become so different from those of other animals? What accounts for our capacity to understand the way the physical world works, to think ourselves into the minds of others, to gossip, read, tell stories about the past, and imagine the future? These questions are not new: they have been debated by philosophers, psychologists, anthropologists, evolutionists, and neurobiologists over the course of centuries. One explanation widely accepted today is that humans have special cognitive instincts. Unlike other living animal species, we are born with complicated mechanisms for reasoning about causation, reading the minds of others, copying behaviors, and using language.

"Cecilia Heyes agrees that adult humans have impressive pieces of cognitive equipment. In her framing, however, these cognitive gadgets are not instincts programmed in the genes but are constructed in the course of childhood through social interaction. Cognitive gadgets are products of cultural evolution, rather than genetic evolution. At birth, the minds of human babies are only subtly different from the minds of newborn chimpanzees. We are friendlier, our attention is drawn to different things, and we have a capacity to learn and remember that outstrips the abilities of newborn chimpanzees. Yet when these subtle differences are exposed to culture-soaked human environments, they have enormous effects. They enable us to upload distinctively human ways of thinking from the social world around us.

"As Cognitive Gadgets makes clear, from birth our malleable human minds can learn through culture not only what to think but how to think it." (From the Publisher)

More information available here.

Hobart, Michael E. (2018) *The Great Rift: Literacy, Numeracy, and the Religion-Science Divide*. Cambridge, MA: Harvard University Press. ISBN 9780674983632

"In their search for truth, contemporary religious believers and modern scientific investigators hold many values in common. But in their approaches, they express two fundamentally different conceptions of how to understand and represent the world. Michael E. Hobart looks for the origin of this difference in the work of Renaissance thinkers who invented a revolutionary mathematical system–relational numeracy. By creating meaning through numbers and abstract symbols rather than words, relational numeracy allowed inquisitive minds to vault beyond the constraints of language and explore the natural world with a fresh interpretive vision.

"The Great Rift is the first book to examine the religion-science divide through the history of information technology. Hobart follows numeracy as it emerged from the practical counting systems of merchants, the abstract notations of musicians, the linear perspective of artists, and the calendars and clocks of astronomers. As the technology of the alphabet and of mere counting gave way to abstract symbols, the earlier "thing-mathematics" metamorphosed into the relational mathematics of modern scientific investigation. Using these new information symbols, Galileo and his contemporaries mathematized motion and matter, separating the demonstrations of science from the linguistic logic of religious narration.

"Hobart locates the great rift between science and religion not in ideological disagreement but in advances in mathematics and symbolic representation that opened new windows onto nature. In so doing, he connects the cognitive breakthroughs of the past with intellectual debates ongoing in the twenty-first century." (From the Publisher)

More information available here.

Howe, Joshua (Ed.) (2017) *Making Climate Change History: Documents from Global Warming's Past*. Vancouver, BC: University of British Columbia Press

> "This collection pulls together key documents from the scientific and political history of climate change, including congressional testimony, scientific papers, newspaper editorials, court cases, and international declarations. Far more than just a compendium of source materials, the book uses these documents as a way to think about history, while at the same time using history as a way to approach the politics of climate change from a new perspective.
>
> "Making Climate Change History provides the necessary background to give readers the opportunity to pose critical questions and create plausible answers to help them understand climate change in its historical context; it also illustrates the relevance of history to building effective strategies for dealing with the climatic challenges of the future." (From the Publisher)

More information available here.

Krawczyk, Daniel (2017) *Reasoning: The Neuroscience of How We Think*. Amsterdam, The Netherlands: Academic Press. ISBN: 9780128092859

> "Reasoning: The Neuroscience of How We Think is a comprehensive guide to the core topics related to a thorough understanding of reasoning. It presents the current knowledge of the subject in a unified, complete manner, ranging from animal studies, to applied situations, and is the only book available that presents a sustained focus on the neurobiological processes behind reasoning throughout all chapters, while also synthesizing research from animal behavior, cognitive psychology, development, and philosophy for a truly multidisciplinary approach. The book considers historical perspectives, state-of-the-art research methods, and future directions in emerging technology and cognitive enhancement.
>
> "(…) this book provides a coherent and structured narrative appropriate for students in need of an introduction to the topic of reason-

ing as well as researchers seeking well-rounded foundational content. It is essential reading for neuroscientists, cognitive scientists, neuropsychologists and others interested in the neural mechanisms behind thinking, reasoning and higher cognition."

More information available here.

Leefmann, Jon & Hildt, Elisabeth (2017) *The Human Sciences after the Decade of the Brain*. Amsterdam, The Netherlands: Academic Press. ISBN: 9780128042052

"The Human Sciences after the Decade of the Brain brings together exciting new works that address today's key challenges for a mutual interaction between cognitive neuroscience and the social sciences and humanities. Taking up the methodological and conceptual problems of choosing a neuroscience approach to disciplines such as philosophy, history, ethics and education, the book deepens discussions on a range of epistemological, historical, and sociological questions about the "neuro-turn" in the new millennium. The book's three sections focus on (i) epistemological questions posed by neurobiologically informed approaches to philosophy and history, (ii) neuroscience's influence on explanations for social and moral behavior, and (iii) the consequences of the neuro-turn in diverse sectors of social life such as science, education, film, and human self-understanding.

"This book is an important resource both for students and scholars of cognitive neuroscience and biological psychology interested in the philosophical, ethical, and societal influences of–and on–their work as well as for students and scholars from the social sciences and humanities interested in neuroscience." (From the Publisher)

More information available here.

Mazzotti, Massimo (2018) *The World of Maria Gaetana Agnesi, Mathematician of God*. Baltimore, MD: Johns Hopkins University Press. ISBN: 9781421425153

> "(…) Mazzotti's original and provocative investigation is also the first targeted study of the Catholic Enlightenment and its influence on modern science. He argues that Agnesi's life is the perfect lens through which we can gain a greater understanding of mid-eighteenth-century cultural trends in continental Europe." (From the Publisher)
>
> "Mazzotti's book succeeds admirably in pushing beyond this summary judgment–the same that judges her curve 'insignificant'–to find in Agnesi's approach to mathematics a way to open a whole world of eighteenth?century life and thought that supported her choices." – Isis
>
> "Mazzotti's account of the rise and fall of a relatively non-gendered intellectual environment in the early eighteenth century thus sheds light on a rare instance in which the Catholic Church actually advocated women's equality. The strangeness of that phenomenon alone renders his work an interesting addition to the history of science." – British Journal for the History of Science
>
> "This book is both a life and a times; it will have many readers." – American Historical Review

More information available here.

Priest, Susanna, Goodwin, Jean & Dahlstrom, Michael F. (Eds.) (2018) *Ethics and Practice in Science Communication*. Chicago, IL: CUP

> "From climate to vaccination, stem-cell research to evolution, scientific work is often the subject of public controversies in which scientists and science communicators find themselves enmeshed. Especially with such hot-button topics, science communication plays vital roles.

Gathering together the work of a multidisciplinary, international collection of scholars, the editors of Ethics and Practice in Science Communication present an enlightening dialogue involving these communities, one that articulates the often differing objectives and ethical responsibilities communicators face in bringing a range of scientific knowledge to the wider world.

"In three sections–how ethics matters, professional practice, and case studies–contributors to this volume explore the many complex questions surrounding the communication of scientific results to nonscientists. Has the science been shared clearly and accurately? Have questions of risk, uncertainty, and appropriate representation been adequately addressed? And, most fundamentally, what is the purpose of communicating science to the public: Is it to inform and empower? Or to persuade–to influence behavior and policy? By inspiring scientists and science communicators alike to think more deeply about their work, this book reaffirms that the integrity of the communication of science is vital to a healthy relationship between science and society today." (From the Publisher)

More information available here.

Wilkins, John S. (2018) *Species: The Evolution of the Idea*. Boca Raton, FL: CRC Press. ISBN 9781138055742

"Over time the complex idea of "species" has evolved, yet its meaning is far from resolved. This comprehensive work is a fresh look at an idea central to the field of biology by tracing its history from antiquity to today. Species is a benchmark exploration and clarification of a concept fundamental to the past, present, and future of the natural sciences. In this edition, a section is added on the debate over species since the time of the New Synthesis, and brings the book up to date. A section on recent philosophical debates over species has also been

added. This edition is better suited non-specialists in philosophy, so that it will be of greater use for scientists wishing to understand how the notion came to be that living organisms form species." (From the Publisher)

More information available here.

Winsberg, Eric (2018) *Philosophy and Climate Science*. Cambridge: Cambridge University Press. ISBN: 9781316646922

"There continues to be a vigorous public debate in our society about the status of climate science. Much of the skepticism voiced in this debate suffers from a lack of understanding of how the science works - in particular the complex interdisciplinary scientific modeling activities such as those which are at the heart of climate science. In this book Eric Winsberg shows clearly and accessibly how philosophy of science can contribute to our understanding of climate science, and how it can also shape climate policy debates and provide a starting point for research. Covering a wide range of topics including the nature of scientific data, modeling, and simulation, his book provides a detailed guide for those willing to look beyond ideological proclamations, and enriches our understanding of how climate science relates to important concepts such as chaos, unpredictability, and the extent of what we know." (From the Publisher)

More information available here.

Schliesser, Eric (2017) *Adam Smith: Systematic Philosopher and Public Thinker*. Oxford: Oxford University Press. ISBN: 9780190690120

"Eric Schliesser's Adam Smith is the product of two decades' reflection by the author on the great Scottish Enlightenment. Unique among

treatments of Adam Smith, Schliesser's book treats him as a systematic philosopher. Smith was a giant of the Scottish Enlightenment with polymath interests; Schliesser thus explores Smith's economics and ethics in light of his other commitments on the nature of knowledge, the theory of emotions, the theory of mind, his account of language, the nature of causation, and his views on methodology. He places Smith's ideas in the context of a host of other philosophers, especially Hume, Rousseau, and Newton; and he draws on the reception of Smith's ideas by Sophie de Grouchy, Mary Wollstonecraft, and other philosophers and economists to sketch the elements of, and the detailed connections within, Smith's system. (…)

"While the book does offer a single argument, it is organized in a modular fashion and includes a helpful index; readers with a more focused interest in Smith's achievements can skip to their section of interest." (From the Publisher)

More information available here.

Smythies, John R., & French, Robert (2018) *Direct versus Indirect Realism: A Neurophilosophical Debate on Consciousness*. London: Elsevier. ISBN: 9780128121412

"Direct versus Indirect Realism: A Neurophilosophical Debate on Consciousness brings together leading neuroscientists and philosophers to explain and defend their theories on consciousness. The book offers a one-of-a-kind look at the radically opposing theories concerning the nature of the objects of immediate perception–whether these are distal physical objects or phenomenal experiences in the conscious mind. Each side–neuroscientists and philosophers–offers accessible, comprehensive explanations of their points-of-view, with each side also providing a response to the other that offers a unique approach on opposing positions.

> "It is the only book available that combines thorough discussion of the arguments behind both direct and indirect realism in a single resource, and is required reading for neuroscientists, neurophilosophers, cognitive scientists and anyone interested in conscious perception and the mind-brain connection." (From the Publisher)

More information available here.

Stanford, Craig (2018) *The New Chimpanzee: A Twenty-First-Century Portrait of Our Closest Kin*. Cambridge, MA: Cambridge University Press. ISBN 9780674977112

> "Recent discoveries about wild chimpanzees have dramatically reshaped our understanding of these great apes and their kinship with humans. We now know that chimpanzees not only have genomes similar to our own but also plot political coups, wage wars over territory, pass on cultural traditions to younger generations, and ruthlessly strategize for resources, including sexual partners. In The New Chimpanzee, Craig Stanford challenges us to let apes guide our inquiry into what it means to be human.
>
> "With wit and lucidity, Stanford explains what the past two decades of chimpanzee field research has taught us about the origins of human social behavior, the nature of aggression and communication, and the divergence of humans and apes from a common ancestor. Drawing on his extensive observations of chimpanzee behavior and social dynamics, Stanford adds to our knowledge of chimpanzees' political intelligence, sexual power plays, violent ambition, cultural diversity, and adaptability.
>
> "The New Chimpanzee portrays a complex and even more humanlike ape than the one Jane Goodall popularized more than a half century ago. It also sounds an urgent call for the protection of our nearest relatives at a moment when their survival is at risk." (From the Publishers)

More information available here.

Thomas, Emily (2018) *Absolute Time: Rifts in Early Modern British Metaphysics*. Oxford: Oxford University Press. ISBN: 9780198807933

> "What is time? This is one of the most fundamental questions we can ask. Traditionally, the answer was that time is a product of the human mind, or of the motion of celestial bodies. In the mid-seventeenth century, a new kind of answer emerged: time or eternal duration is 'absolute', in the sense that it is independent of human minds and material bodies.
>
> "Emily Thomas explores the development of absolute time or eternal duration during one of Britain's richest and most creative metaphysical periods, from the 1640s to the 1730s. She introduces an interconnected set of main characters - Henry More, Walter Charleton, Isaac Barrow, Isaac Newton, John Locke, Samuel Clarke, and John Jackson - alongside a large and varied supporting cast, whose metaphysical views are all read in their historical context and given a place in the seventeenth- and eighteenth-century development of thought about time." (From the Publisher)

More information available here.

Authors of HPS&ST-related papers and books are invited to bring them to attention of the Note's assistant editors, Paulo Maurício at paulo.asterix@gmail.com or Nathan Oseroff at nathanoseroff@gmail.com for inclusion in these sections.

## Coming HPS&ST Related Conferences

April 3-6, 2018, "Science, Imagination and Wonder: Robert Grosseteste and His

Legacy" Pembroke College, Oxford, UK
More information at: https://ordered-universe.com/oxford-conference/
And, Seb Falk sldf2@CAM.AC.UK

April 4-6, 2018, BSHS Postgraduate Conference 2018, Centre for the History of Science, Technology and Medicine (CHSTM), University of Manchester, UK.
Details at: http://www.bshs.org.uk/conferences/postgraduate-conference

April 6-7, 2018, Humanities for STEM: Using Archives to Bridge the Two Culture Divide, NYU Tandon School of Engineering in Brooklyn, NY.
Inquiries: humanitiesforSTEMsymposium@nyu.edu

April 6-7, 2018, Learning from Empirical Approaches to HPS. Center for Philosophy of Science, University of Pittsburgh, Pittsburgh, PA, USA
More information available here.

April 12-14, 2018, BSHP Conference 2018: Habit in The History of Philosophy. University of Durham, UK.
More information at: http://www.bshp.org.uk/confevents/annualc

April 18-20, 2018, Evolution and Moral Epistemology, Utrecht University, The Netherlands.
More information at: http://www.evoethics.com/evolution-and-moral-epistemology-2018.html

April 19-20, 2018, Research Workshop on Science, Technology, Society (STS)/History, Technology, Society (HTS): Bioeconomy, Biotechnology, Medical Technologies. National and Kapodistrian University of Athens, Athens, Greece.
Details at: http://old.phs.uoa.gr/hst/files/2nd_CfP_STS_HTS_Workshop.pdf

April 26, 2018, Graduate Philosophy Conference, Department of Philosophy, National Taiwan University.
More information at: http://ntu-graduate-philosophy-conference.webnode.tw/

May 3-4, 2018, 7th Annual University of Calgary Graduate Philosophy Conference.

University of Calgary, Alberta, Canada.
Details at: https://ucalgarygradconference.wordpress.com/

May 10-11, 2018, 2nd International Conference on Bioethics in the New Age of Science, Szeged, Hungary.
Details at: http://www.bnas2018.org/

May 12-13, UK Antiquarian Horological Society, annual meeting, Keele University, Staffordshire.
Details at: http://www.ahsoc.org/events/annual-meeting/

May 16-18, 2018, V Colombian Conference on Logic, Epistemology and Philosophy of Science (PHILOGICA V), Villa de Leyva, Colombia
Details available here.

May 17-18, 2018, Philosophy of Biology at the Mountains (POBAM), University of Utah, Salt Lake City, US.
Details at: https://sites.google.com/view/pobam/home

May 17-20, 2018, The 8th Annual Values in Medicine, Science, and Technology Conference. The University of Texas at Dallas, Richardson, Texas, USA
Details at: http://www.utdallas.edu/c4v/2018-conference/

May 18-20, 2018, 46th annual meeting of the Society for Exact Philosophy. University of Connecticut, USA
More information at: http://www.phil.ufl.edu/SEP/meeting/2018/index.html

May 23-25, 2018, Workshop on Explanation and Understanding. Ghent University
More information at: http://www.lrr.ugent.be/explanationunderstanding/

May 24-26, 2018, 4th International Workshop on Historical Epistemology: Historical epistemology and the disunities of the sciences. Université Paris 1 Panthéon-Sorbonne
More information at: https://episthist.hypotheses.org/1016

May 26-28, 2018, CSHPS Annual Meeting, Regina, Canada

Details at: http://www.yorku.ca/cshps1/meeting.html

May 28-30, 2018, Closing International Workshop: Democratisation of science – epistemological issues and new perspectives. Université de Lyon, France
More information at: https://tinyurl.com/y7vbrewt

May 31, June 1, 2018, Is Religion Natural?, Centre for Ethics and the Centre Pieter Gillis, University of Antwerp (Belgium)
Inquiries with Esther Kroeker: esther.kroeker@uantwerpen.be.

June 1-2, 2018, Fake Knowledge, Department of Philosophy, University of Cologne, Germany.
More information: Dr. Amy Flowerree (aflowerr@uni-koeln.de) Abstract submission: March 15, 2018.

June 4-6, 2018, Consortium for Socially Relevant Philosophy of/in Science and Engineering (SRPoiSE) 4th Conference, Academy of Medicine at Georgia Tech, Atlanta, USA
Details at: http://srpoise2018.weebly.com

June 4-7, 2018, Canadian Philosophical Association: 2018 Annual Congress. Montreal, Quebec, Canada
More information at: https://www.acpcpa.ca/cpages/home-page

June 7-8, 2018, The Spirit of Inquiry in the Age of Jefferson. American Philosophical Society, Philadelphia.
Details at: https://www.amphilsoc.org/spirit-inquiry-age-jefferson

June 11-13, 2018, Models of Explanation. 11th Munich-Sydney-Tilburg/Turin (MuST) Conference in Philosophy of Science. University of Turin.
Details at: https://modelsofexplanation.wordpress.com/

June 14-15, 2018, Explanatory Power. A workshop in the DACH project: Inferentialism, Bayesianism, and Scientific Explanation. University of Geneva.
More information at: http://www.unige.ch/lettres/philo/files/1114/9917/0204/

Explanatory_Power.pdf
Inquiries to: lorenzo.casini@unige.ch

June 14-16, 2018, Phenomenological Approaches to Physics Historical and Philosophical Perspectives, University of Graz, Austria
Details at: http://phenphysics.weebly.com/

June 18-20, 2018, Society of European Philosophy and Forum for European Philosophy Annual Conference, University of Essex, UK.
More information available here.

June 18-20, 2018, 5th Annual Conference of the International Association for the Philosophy of Time (IAPT), Seoul, South Korea.
More information at: https://iapt5seoul.weebly.com/

June 19-21, 2018, 7th annual conference of the Society for the Study of the History of Analytical Philosophy (SSHAP 2018), Hamilton, Ontario
More information at: http://sshap.org/category/meetings/annual-meetings/

June 22-24, 2018, Bertrand Russell Society Annual Meeting 2018, McMaster University in Hamilton, Ontario
More information at: http://bertrandrussell.org/annual-meeting-2018/

June 22-23, 2018, Computational Modelling in Philosophy (CMP). Munich Center for Mathematical Philosophy (MCMP) - LMU Munich.
Details at: https://tinyurl.com/y9tpvq9m

June 27-29, 2018, Reconceiving Cognition, Antwerp, Belgium
More information at: https://www.uantwerpen.be/en/rg/filop/reconceiving/

June 27-29, 2018, Measurement at the Crossroads. University Paris Diderot, France.
Details at: https://measurement2018.sciencesconf.org/

June 29-July 1, 2018, Annual Conference of the Society for Applied Philosophy. Utrecht, The Netherlands.
More information available here.

June 30-July 2, 2018, 7th SPSP Congress, Ghent University, Belgium
Details, Erik Weber, Erik.Weber@UGent.be.

July 3-6, 2018, 9th Conference of the International Society for the Study of Argumentation (ISSA), University of Amsterdam, The Netherlands
Details at: https://www.conftool.net/issa2018/

July 4-6, 2018, VIIème Congrès de la Société de Philosophie des Sciences, Nantes, France.
Details at: https://congressps.sciencesconf.org/resource/page/id/1

July 4-6, 2018, BSPS 2018 Annual Conference, University of Oxford, UK
More information available here.

July 5-7, 2018, The Evolution of Knowledge. &HPS7: Integrated History and Philosophy of Science, 7th conference. Leibniz Universität Hannover, Hannover, Germany
Inquiries to: Uljana Feest feest@philos.uni-hannover.de
Or, Ohad Parnes oparnes@mpiwg-berlin.mpg.de

July 9-12, 2018, HOPOS 2018 International Conference, Groningen, the Netherlands
Details at: http://www.hopos2018.nl/

July 16-18, 2018, Annual Conference of the International Society for the Philosophy of Chemistry (ISPC). Department of Philosophy, University of Bristol, UK
Inquiries to gb0859@bristol.ac.uk
More information at: https://sites.google.com/site/socphilchem/

July 17-19, 2018, Eight International Conference on Language, Culture and Mind.
Venue: Denison University in Granville, Ohio, USA
Details at: https://conferences.denison.edu/lcm8/

July 17-21, 2018, International Committee for the History of Technology, 45th

symposium, Jean Monnet University, Saint-étienne, France.
Further information at: http://www.icohtec.org/annual-meeting-2018.html

July 19-27, 2018, 2018 Summer Institute; From Biological Practice to Scientific Metaphysics. Taipei, Taiwan
Details available here.

July 23-27, 2018, The 2018 Conference on Artificial Life (ALIFE 2018), Tokyo, Japan.
Details at: http://2018.alife.org/

July 29 – August 2, 2018, 25th Biennial Conference in Chemical Education, University of Notre Dame, Notre Dame, IN, USA
Details at: http://bcce2018.org/Default.html

August 5-11, 2018, 41st International Wittgenstein Symposium. Kirchberg am Wechsel, Austria.
Details at: http://www.alws.at/index.php/symposium/view/call_for_papers/

August 20-21, 2018, First International Conference on Philosophy and Meaning in Life, Sapporo, Japan
More information at: http://caep-hu.sakura.ne.jp/en/event/

August 22-24, 2018, Society for the Metaphysics of Science (4th Annual Conference), Milan, Italy.
Further information: Christina Conroy at c.conroy@moreheadstate.edu

August 29 – September 1, 2018, Society for Social Studies of Science – Transnational STS, Sydney, Australia
Details at: http://www.4sonline.org/item/4s_sydney_18_announced

September 3-5, 2018, 4th Latin American Conference of the International History, Philosophy and Science Teaching Group (IHPST-LA), Federal University of ABC, UFABC, Santo André, Brazil
Information at: http://www.brenoam.com/ihpstla-2018-en.

September 10-12, 2018, The Insides of Nature: Causalities, Causal Processes and Conceptions of Nature. Faculdade de Filosofia e Ciências Sociais Universidade Católica Portuguesa, Braga, Portugal
More information at: http://braga.ucp.pt/filosofiadanatureza/eng.html#

September 14-17, 2018, European Society for the History of Science Biennial Conference and British Society for History of Science annual conference, 'Unity and Disunity', University College London's Institute of Education, London, UK
More information at: http://eshs2018.uk/index.php/call-for-papers/
For further details please contact the Programme Co-ordinator, Frank James: fjames@ri.ac.uk.

September 17-20, 2018, Tenth international conference (GAP.10) of the German Society for Analytic Philosophy (GAP), Cologne, Germany
More information at: https://gap10.de/en/

September 26-28, 2018, Deuxième colloque de la SFHSH - Histoire des sciences humaines et sociales. Paris, France.
Details at: https://sfhsh.hypotheses.org/1018

October 2-6, 2018, XIII International Ontology Congress: Physics and Ontology. San Sebastian (University of the Basque Country) and Barcelona Autonomous University of Barcelona, Spain.
Details at: http://www.ontologia.info/

October 17-21, 2018, 3rd International Conference on the History of Physics under the auspices of the European Physical Society, Donostia-San Sebastian (Spain)
Details at: http://www.ehu.eus/ehusfera/hopdss2018/

November 1-4, 2018, 26th Biannual Meeting of Philosophy of Science Association, Seattle, Washington.
More information available here.

November 13-16, 2018, IX conference of the Spanish Society of Logic, Methodology and Philosophy of Science (SLMFCE), Madrid, Spain.

More information at: http://www.solofici.org/congreso2018/

November 23-28, 2018, East Asian Science Education Association (EASE) annual conference, National Dong Hwa University, Hualien Taiwan.
Details at: http://new.theease.org/conference2018.php

March 31-April 3, 2019, NARST Annual Conference, Baltimore, USA
Details at: https://www.narst.org/