Inventing a New Discipline

Fourth Annual Bulletin

2020

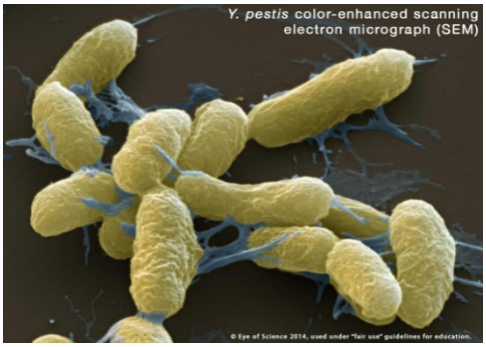
"A year like no other." That comment about 2020 shows how much work lies ahead of the Science of the Human Past and the power of science to uncover the roots of today, embedded in a neglected past.

In fact, 2020 fades in comparison to 542 and 1348 C.E., when great pandemics of bubonic plague swept across western Eurasia and Africa, or even the 1918 influenza pandemic. And let's not forget 536, when sudden climate change set the hemispheric stage for crisis. The investigations of past pandemics we launched five years ago are invaluable to understanding our current global predicament. As you may imagine, our SoHP team fielded numerous press and scholarly inquiries regarding its research on great pandemics of the past: from the international spread of pathogens to the environmental factors which escalate each event, and the lessons to be learned at every turn. The discoveries of the Science of the Human Past continue, and their relevance to the present has never been clearer, even if that very relevance, the pandemic itself, and the requests for a historical perspective have delayed the delivery of this annual bulletin.

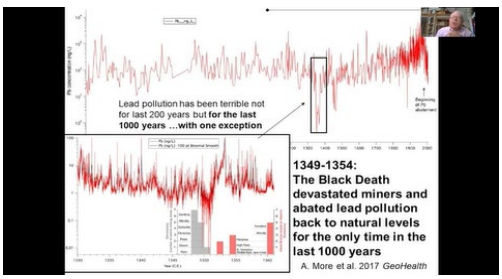
This report brings you up to date about the **Initiative for the Science of the Human Past at Harvard (SoHP)** and its activities, particularly at our **Max Planck-Harvard Research Center**, the **Historical Ice Core Project**, SoHP's **Educational Mission**, its **People** and **Projects** **in 2020**.

The Max Planck-Harvard Research Center for the Archaeoscience of the Ancient Mediterranean (MHAAM), Cambridge and Boston, Jena and Leipzig (Germany)

Created to discover ancient pathogens and migrations, MHAAM's pathogen research was very much in the spotlight this year. While our painstaking genomic and historical research into the Roman and Black Death pandemics of bubonic plague continued quietly at Harvard and Jena, the public demand for information about our discoveries was nearly insatiable. MHAAM Co-Director Michael McCormick was featured on the UK's Channel 4 ("How Pandemics Shape History"); Oxford University's "Futuremakers" devoted an entire podcast to how MHAAM's unique tool kit of advanced philology, historical expertise, archaeology, and ancient DNA recovery and genomic analysis is transforming our knowledge of the devastation caused by the little-known Justinianic Pandemic (541-~700 CE) that coincided with the end of the ancient world. McCormick also spoke about MHAAM's discoveries in "What History Teaches us about Pandemics" for the livestreamed Harvard History Department Seminar series last spring.

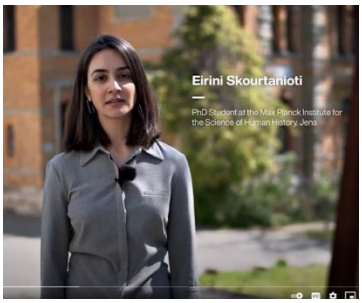


Yersinia Pestis Bacteria: cause of Bubonic Plague



What History Teaches Us About Pandemics

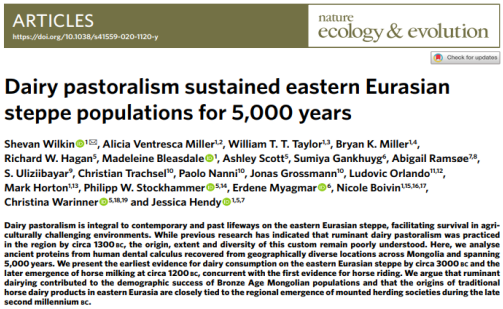
The timely research of SoHP/MHAAM graduate student John Mulhall was highlighted by the Washington Post as lessons to be learned from Milan's response to the bubonic plague in the 14th



Video for Cell article: ancient migration patterns revealed

and 15th centuries. MHAAM's ongoing archaeogenetic investigations are now uncovering the evolution of the human pathogen *Salmonella enterica* and its relationship to cultural transformations. The entire U.S.-German MHAAM team met via virtual workshop last fall to discuss our most recent research on the spread of ancient pathogens (*Streptococcus mutans* and *Yersinia pestis*) and on new genomic evidence for ancient human mobility in Armenia, Anatolia, the Aegean, Phoenicia, Serbia, and the Italian peninsula.

MHAAM's mobility investigations also produced this year new discoveries on the human genetic histories of Sardinia, Sicily, and the Balearic Islands, the Levant, Anatolia and the Southern Caucasus, and the Eastern Eurasian Steppe; revealed dietary practices through new investigations focusing on both hydrogen isotopes in dentin collagen and proteomics, and developed new protocols towards interdisciplinary study of human history hidden in ancient teeth through DNA *and* protein analyses.


ARTICLES
https://doi.org/10.1038/s41559-020-1120-y
nature ecology & evolution

Dairy pastoralism sustained eastern Eurasian steppe populations for 5,000 years

Shevan Wilkin[1,52], Alicia Ventresca Miller[1,2], William T. T. Taylor[1,3], Bryan K. Miller[1,4], Richard W. Hagan[5], Madeleine Bleasdale[1], Ashley Scott[5], Sumiya Gankhuyg[6], Abigail Ramsøe[7,8], S. Uliziibayar[9], Christian Trachsel[10], Paolo Nanni[10], Jonas Grossmann[10], Ludovic Orlando[11,12], Mark Horton[1,13], Philipp W. Stockhammer[5,14], Erdene Myagmar[6], Nicole Boivin[1,15,16,17], Christina Warinner[5,18,19] and Jessica Hendy[1,5,7]

Dairy pastoralism is integral to contemporary and past lifeways on the eastern Eurasian steppe, facilitating survival in agriculturally challenging environments. While previous research has indicated that ruminant dairy pastoralism was practiced in the region by circa 1300 BC, the origin, extent and diversity of this custom remain poorly understood. Here, we analyse ancient proteins from human dental calculus recovered from geographically diverse locations across Mongolia and spanning 5,000 years. We present the earliest evidence for dairy consumption on the eastern Eurasian steppe by circa 3000 BC and the later emergence of horse milking at circa 1200 BC, concurrent with the first evidence for horse riding. We argue that ruminant dairying contributed to the demographic success of Bronze Age Mongolian populations and that the origins of traditional horse dairy products in eastern Eurasia are closely tied to the regional emergence of mounted herding societies during the late second millennium BC.

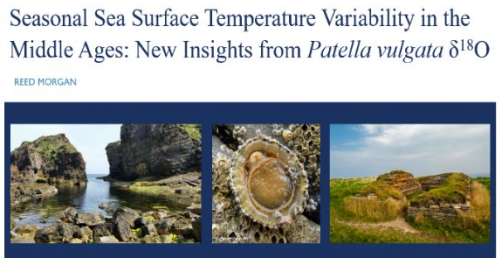
Nature Ecology & Evolution, March 2, 2020

MHAAM-funded OEB graduate Eadaoin Harney

MHAAM continues to foster a new generation of intrepid researchers pioneering the frontiers of science and history. Dr. Éadaoin Harney, recipient of MHAAM graduate fellowship funding (2017–19), completed her Ph.D. in the Harvard Department of Organismic and Evolutionary Biology. MHAAM funding supported Éadaoin's investigation of population genetics, and particularly her path to become lead author on the ancient DNA study of skeletal remains (previously considered "mysterious") at Roopkund Lake in the Himalayas, as featured in *The New York Times*, *National Geographic*, *The Atlantic*, among others.

MHAAM-funded HEB graduate student Megan Michel

Three current fully-funded MHAAM PhD students continue to advance at Harvard: Aurora Allshouse's (Department of Anthropology) dissertation investigates ancient health and nutrition under Prof. Christina Warinner's guidance; Megan Michel (Human Evolutionary Biology) is analyzing *Streptococcus mutans* data from samples she processed in the aDNA labs in Jena, Germany; and Reed Morgan (History) is studying population genetics, medieval history and much more in his 2nd year at Harvard. Reed presented his shell isotope research into medieval climate at the American Malacological Society's 86th Annual Meeting in July 2020.


Seasonal Sea Surface Temperature Variability in the Middle Ages: New Insights from *Patella vulgata* $\delta^{18}O$

REED MORGAN

Reed Morgan's shell isotope research presentation

In view of the magnificent results of the first 4.5 years of this transatlantic collaboration—with 23 high-profile publications in 4.5 years—the Max Planck Society in Germany has approved MHAAM's renewal for 5 more years (2021-26).

Matching this funding commitment on the Harvard end has proven more challenging for the renewal of the U.S. activities of the Research Center, given COVID-induced financial setbacks at the

University. Nevertheless, we persevere with grant applications to external sources and other efforts, particularly by our network of generous supporters, to raise the requisite resources in the U.S. for this remarkably successful collaboration.

Historical Ice Core Project (HICP): Past Environments, Pandemics and Economies


CNN health Food Fitness Wellness Parenting Vital Signs

How climate change affects pandemics

By Lauren Kent, CNN

Updated 8:32 AM ET, Mon September 28, 2020

The 1918 flu coincided with the final years of the World War I, and it's been well documented that heavy rain and cold temperatures impacted many battles. Now, a new study reveals that the cold, rainy weather was part of a once-in-a-century climate anomaly that occurred from 1914 to 1919 and added to the severity of the 1918 pandemic.

Alexander More, Research Associate in the Initiative for the Science of the Human Past at Harvard and Assistant Professor at the Climate Change Institute, University of Maine.

"We knew before, of course, from photos and eyewitness testimonies that the battlefields of Europe were really muddy and rainy and soldiers died of all sorts of exposure, even drowning in the mud and the trenches sometimes. What is news is that in fact it was a six-year anomaly and not just one or two instances," said lead researcher Alexander More, a research associate at Harvard University's history department and an assistant professor at the University of Maine's Climate Change Institute.

CNN Article, September 28, 2020

This past September, during Climate Week, our research team at Harvard and our partners at the Climate Change Institute (CCI) at the University of Maine published a new study detailing how a six-year climate anomaly exacerbated the mortality of WWI and of the Spanish Flu Pandemic of 1918. By combining our high-resolution natural climate record with epidemiological, instrumental and historical records, Dr. Alexander More (Research Associate at SoHP), Prof. Christopher Loveluck and the team provided new insights into the virulence of the "Spanish Flu," coincidentally at a time when the modern world was experiencing the second wave of the COVID-19 pandemic. Receiving global news coverage from CNN, *The Washington Post*, *Forbes*, and news outlets worldwide, our article is now ranked #1 in the history of the American Geophysical Union journal *GeoHealth* in terms of views and downloads, and scored in the top 5% of all articles tracked by Altmetrics. As our work continues to shed light on past pandemics and climate crises, team members are called upon as experts in assessing the impact of our current pandemic in comparison to similar events in the past.


SCIENTIFIC AMERICAN

CLIMATE

Saharan Dust Plume Kicking Up Climate Questions

Whether these plumes—which can dampen hurricane activity and irritate lungs—will become more common with warming is unclear

HICP-CCI graduate Heather Clifford

Scientific American, June 26, 2020

In late 2019, our team also published a detailed study of the impact of Saharan dust events on the climate of Europe for the last 2000 years. Heather Clifford (HICP-CCI Ph.D student and first author) with the rest of the HICP team combined Europe's highest-resolution natural climate record –our ice core– with detailed historical records. The article shed light on past periods in which warm Saharan dust storms intensified and crossed the seas, providing sobering insights into what we may expect in the future when such natural events converge with manmade climate change. If past mildly warmer periods propelled the economy of Europe to new demographic and economic heights, the natural warming variation marked by Saharan dust events will likely turbocharge human impact on our modern climate, including stronger dust storms which will degrade air quality and thus the health of populations in and beyond the Mediterranean. The article preceded, by a few months, the arrival of just such a Saharan dust storm in June 2020—the strongest since instrumental records began two decades ago—which prompted *Newsweek*, CBS and *Scientific American* media to cover our research in their reports on the Saharan dust plume which crossed the Atlantic and reached the southeastern US.


THE TIMES

Today's sections | Past six days | Explore | Times Radio

Clue to murder of Thomas Becket buried in the ice of a Swiss glacier near Zermatt

Mark Bridge, History Correspondent

Wednesday April 01 2020, 12.00am BST, The Times

Christopher Loveluck Professor of Archaeology

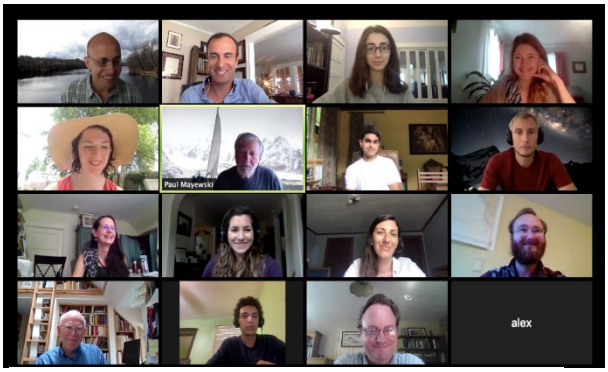
Times of London, April 1, 2020

The Historical Ice Core team published a new study in *Antiquity* highlighting the periods of highest pre-modern lead

pollution documented in our natural ice-core and historical records. Combing through medieval Pipe Rolls and fiscal documents, Prof. Christopher Loveluck (Univ. of Nottingham and former SoHP visiting professor) and our team charted the rhythm of political and economic changes in the empire of Henry II, Eleanor of Aquitaine, and Richard Lionheart, and linked it to the rise and fall of metal production as measured by pollution in our ice-core record. After documenting in 2017 the lowest levels of pollution in 1000 years during the Black Death Pandemic, the new study completed the picture, drawing worldwide press coverage, including Science, BBC, *Times of London*, and *Smithsonian Magazine*. A handsome fillip for our project came when a journal that communicates innovative methodologies among scientists wrote a beautiful overview of the advances in technology and interdisciplinary investigation pioneered by the Climate Change Institute and SoHP with the Colle Gnifetti ice core: "Frozen in Time" was published in *The Analytical Scientist* in June 2020.

SoHP's Educational Mission: teaching with research

In a dynamic summer 2020 internship program, five Harvard undergraduates learned to create and revise climate and environmental geodatabases using non-digitized works and new datasets to expand our innovative free digital historical atlas, painstakingly created by Harvard students over the past 10 years. Working side by side with our team leaders, they focused on paleoclimate change and participated in Historical Ice Core workshop meetings with our colleagues at the Climate Change Institute, at the University of Maine.

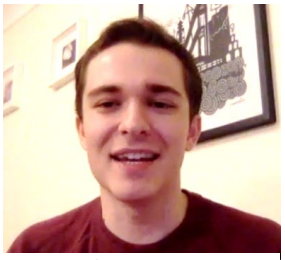


Historical Ice Core Project Summer Workshop

Forced to innovate by the Pandemic, the October **Annual MHAAM Young Investigator Symposium** seized the moment and went virtual and more global than ever, bringing together 20 undergraduate and Master's students from 15 countries in Africa, Asia, Europe and the Americas to share their interdisciplinary research on the science of the human past with MHAAM faculty and

4th Annual Young Investigator Symposium

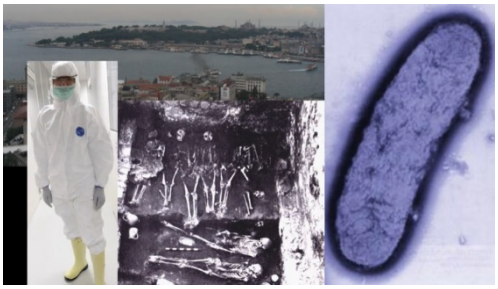
advisors—a testament to the growing field of archaeoscience and the eagerness for early career students to learn from and network with others similarly engaged.



Carter Wilcox presents to HIST 1040

Carter J. Wilcox (Harvard College '20) became the second SoHP undergrad to win a coveted **Hoopes Prize**, for his senior thesis, "Big Data, Brooches, and Boudica: Using Computational Methods To Reveal New Historical Puzzles 600 BC – 410 AD." Using big data from the U.K. Portable Antiquities Scheme and clever computational techniques, Carter was able to make new discoveries on how archaeologicical objects reveal human mobility during the Roman occupation of Britain. As he notes, "joining SoHP was the single best decision I made at Harvard. From an academic perspective, the cross-divisional faculty taught me how to combine qualitative and quantitative techniques to perform cutting-edge research: an interdisciplinary approach that I struggled to find elsewhere." Carter's research was also awarded the Philip Washburn Prize for best thesis on a historical subject. From the UK, Carter gave a special presentation on his research to students of McCormick's "Fall of the Roman Empire" course this fall. Next autumn, Carter will take his talents and experience to an M.B.A. at the Harvard Business School.

That course, History 1040, attracted over 70 undergraduate students to study the intersection of archaeoscience and history in an online format spanning ice cores, genomics, ancient pandemics, trade, gender, invasion and migration – successes and crises – in concert with close reading of ancient documents tracing the rise and fall of empire … yet now with all the features that the digital humanities can provide.



HISTORY 1040: The Fall of the Roman Empire

At the height of the COVID-19 pandemic, SoHP professor **Christina Warinner** and MHAAM teaching fellow **Megan Michel** offered the undergraduate course "Sick: 10,000 Years of Human Health and Disease." Although the timing of the course vis-à-vis the pandemic was unplanned, it provided an apt opportunity to explore in real time the social and biological dimensions of past and present epidemics. Surveying cross-cultural concepts of disease and examining the major nutritional and infectious diseases that have impacted human populations over the past ten thousand years, the course also drew upon real world, unfolding events in the COVID-19 pandemic to explore not only the biology of disease, but also how social structures and attitudes influence the trajectory of epidemics and shape the course of history. Students learned to analyze and interpret archaeological, paleogenomic, and historical data through detailed case studies of pellagra, scurvy, smallpox, plague, influenza, cholera, *cocoliztli*, and tuberculosis, and they learned about epidemiology and how the immune system works by tracking newly released COVID-19 data and studying vaccine biology from its origins in smallpox variolation to the race for a global coronavirus vaccine. Guest experts joined the class, and students led *guided interviews* with these experts to discover the research process behind major scientific discoveries in palaeopathology and ancient DNA, while sections were organized around *virtual labs*. There may never be another semester quite like the fall of 2020, but for all the challenges that the pandemic brought, it has never been more clear how relevant the past is for our future.

MHAAM Deputy Director **David Reich**, now in the Faculty of Arts and Sciences Department of Human Evolutionary Biology as well as at Harvard Medical School, offered "Ancient DNA as a Window Into the Human Past," in which the centerpiece was an original undergraduate research project analyzing unpublished data generated in the lab. Senior Michael Cheng '22 commented, "the most exciting part about the course was getting to work with a fantastic mentor, Éadaoin Harney, and directly contributing to an ongoing research project in ancient DNA. My project was titled 'Understanding West African Ancestry Using PCA' and it involved analyzing genome-wide data from West African populations to understand the history of the transatlantic slave trade. I really enjoyed working with a new form of historical evidence, ancient DNA data, to understand the past."

SoHP Steering Committee member **Peter Huybers** (Earth and Planetary Sciences) taught "Human Environmental Data Science: Agriculture, Conflict, and Health," where students addressed a major question at each interface: Have agricultural systems been adapted to climate change? Has drought caused conflict? And does the environment influence the spread of COVID-19? Analytical approaches included simple mathematical models of feedback systems, crop development, and population disease dynamics, along with frequentist statistical techniques and Bayesian methods; undergraduates worked in small teams on independent research projects.

McCormick and Harvard College '19 alum Sonja Eliason met with Harvard alumni in London to describe SoHP's unique work connecting Harvard students with cutting-edge research on pandemics and pathogens, ancient health and nutrition, migration, and paleoclimate change, including Sonja's senior thesis research in Germany in the aDNA lab of our MHAAM partner. Sonja is pursuing her career in the biotech industry.

Sonja Eliason at MPI-SHH, Jena, Germany

All told, during the past year 15 undergraduates and 9 graduate students were employed in SoHP projects, with research ranging from climate change and pandemics past to global migration, trade networks, and cyclic economic upheaval. And a total of 115 Harvard undergrads were enrolled during the Fall term in SoHP courses, gaining broad exposure to our unique interdisciplinary approach!

People

Prof. Christina Warinner

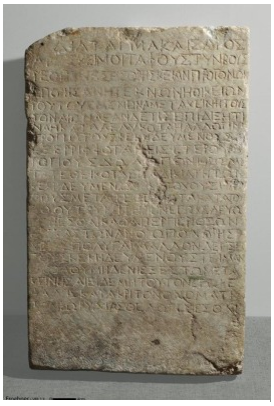
Dr. **Christina Warinner** has returned to Harvard as Assistant Professor in the FAS Department of Anthropology, and Sally Starling Seaver Assistant Professor at the Radcliffe Institute for Advanced Study. She is also Group Leader, Microbiome Sciences, Max Planck Institute for the Science of Human History, and Professor of Biological Sciences, Schiller University, Jena, Germany. As an expert in the proteomic and aDNA study of ancient health and nutrition, Tina brings a wealth of experience to Harvard; she has now joined the Steering Committee for SoHP as well as the leadership team of MHAAM, collaborating on new directions for explorations of the past. It is a special delight to note that, while still a graduate student at Harvard, Tina had collaborated in the meetings and projects which would give rise to the Science of the Human Past. This year, Tina hired Dr. Kristine Richter as her new

laboratory manager, and her lab has already started generating their first Zooarchaeology-by-Mass Spectrometry (ZooMS) data: this consists of generating peptide mass fingerprints from collagen data to make species identifications of archaeological animal bones.

SoHP Steering Committee member **Dan Smail** and colleagues published the online Documentary Archaeology of Late Medieval Europe (DALME) collection, and are currently developing the tools to enable sophisticated quantitative and relational analyses, with the goal of reconstituting the material environment of the societies of the medieval past.

Just before the pandemic hit, SoHP Chair **Michael McCormick** gave the Katritzky Lecture at St. Catherine's College, Oxford University on "Climate, History and Change: Reflections on a 21st-Century Challenge" and spoke further at All Souls College on interdisciplinary collaboration, "From GIS to ice-cores via a Visigothic capital and Justinian's Pandemic: Recent work with the Science of the Human Past."

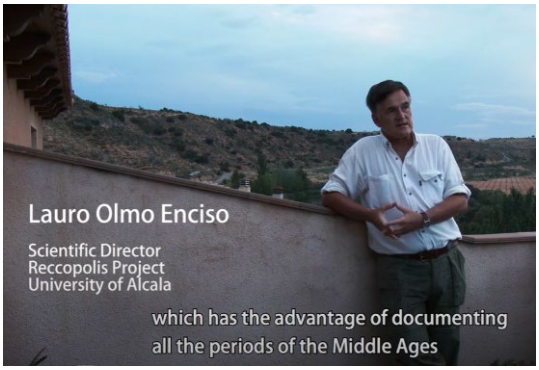
Projects



Nazareth Inscription

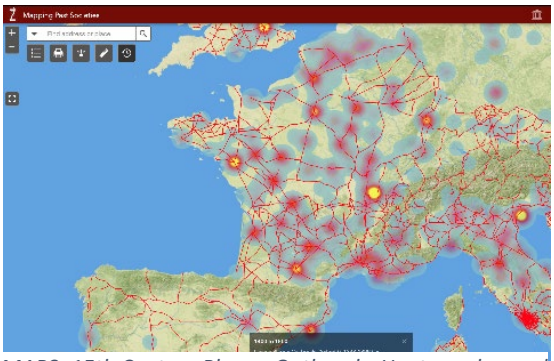
Along with **Kyle Harper** (*Professor of Classics and Letters, University of Oklahoma*), another former Harvard Ph.D. student who pioneered those early archaeoscientific meetings and projects alongside Prof. Warinner, McCormick co-authored "Establishing the provenance of the Nazareth Inscription: Using stable isotopes to resolve a historic controversy and trace ancient marble production," which used isotopes to prove that the stone used for the so-called **Nazareth Inscription**—claimed as the earliest material evidence for Jesus' crucifixion and his Christian followers—actually came from a Greek quarry and reflects Aegean circumstances, not Nazareth and Jesus' resurrection. But the method's promise is even greater: applied to the thousands of dated inscriptions, the new method described in this pioneering article will allow economic historians for the first time to **quantify Roman economic activity**—the building industry—on a yearly basis.

Although the COVID-19 pandemic blocked archaeological operations this year at SoHP's collaborative project at the **Visigothic royal capital** of Reccopolis (Spain), our partners at the German Institute of Archaeology (DAI) released a new video documenting how SoHP is catalyzing innovative scientific discoveries about the origins of medieval Spain in its non-destructive prospection collaboration with Universidad de Alcalá, and the DAI, coming to a YouTube channel near you!



YouTube: Next-Generation Archaeology at Reccopolis

One of SoHP's earliest open-access programs, the ***Digital Atlas of Roman and Medieval Civilizations*** successfully competed for funding for a complete overhaul. It was awarded bridge support from the FAS Dean's Competitive Fund for Promising Scholarship, thanks to which SoHP will soon publicly launch its new ArcGIS Online platform**, Mapping Past Societies (MAPS)** under Managing Editors Santiago Pardo Sánchez (College '16) and Dr. More (PhD '14). MAPS will substantially increase features and map layers as this online resource expands coverage over time and space. Created primarily by the research of Harvard undergrads, this digital atlas has, for a decade, served as a teaching tool in universities and high schools worldwide, reaching over two-and-a-half million visits last year. The combination of historical, archaeological and other evidence from the humanities with map layers from other disciplines has breathed new life into known but undigitized data—now available in open access to everyone—and allowed discoveries in archaeology, the history of art, science and medicine, intellectual history, linguistics, and economic history.



MAPS: 15th Century Plague Outbreaks Heatmap layered over Roman Roads

We have been able to achieve so much in difficult times thanks to the resources made available by our generous supporters, particularly the Arcadia Fund of London, HUCE, FAS, and you, our individual supporters.

The SoHP team wishes to convey to you, our supporters and colleagues, our deepest gratitude for your continued interest in the rapidly growing new discipline revolutionizing the Science of the Human Past, with hopes for a prosperous *and healthy* year. Stay tuned for new discoveries as they unfold: our international teams of dedicated researchers and student scholars are intent on revealing the untold history of human health, migration, and economic gains and setbacks across millennia. As we face this brave new world together, we will continue to explore its roots and our own embeddedness in the past – *together.*