

## References

### Aktuell

#### BENZELL 2020

Seth G. Benzell, Avinash Collis & Christos Nicolaides, *Rationing social contact during the COVID-19 pandemic, Transmission risk and social benefits of US locations*. [PNAS 117 \(2020\), 14642–14644](#). [DOI:10.1073/pnas.2008025117](#).

To prevent the spread of coronavirus disease 2019 (COVID-19), some types of public spaces have been shut down while others remain open. These decisions constitute a judgment about the relative danger and benefits of those locations. Using mobility data from a large sample of smartphones, nationally representative consumer preference surveys, and economic statistics, we measure the relative transmission reduction benefit and social cost of closing 26 categories of US locations. Our categories include types of shops, entertainments, and service providers. We rank categories by their trade-off of social benefits and transmission risk via dominance across 13 dimensions of risk and importance and through composite indexes. We find that, from February to March 2020, there were larger declines in visits to locations that our measures indicate should be closed first.

Keywords: COVID-19 | social contact | transmission risk | social welfare

#### BONACCORSI 2020

Giovanni Bonaccorsi et al., *Economic and social consequences of human mobility restrictions under COVID-19*. [PNAS 117 \(2020\), 15530–15535](#). [DOI:10.1073/pnas.2007658117](#).

[pnas117-15530-Supplement.pdf](#)

In response to the coronavirus disease 2019 (COVID-19) pandemic, several national governments have applied lockdown restrictions to reduce the infection rate. Here we perform a massive analysis on near-real-time Italian mobility data provided by Facebook to investigate how lockdown strategies affect economic conditions of individuals and local governments. We model the change in mobility as an exogenous shock similar to a natural disaster. We identify two ways through which mobility restrictions affect Italian citizens. First, we find that the impact of lockdown is stronger in municipalities with higher fiscal capacity. Second, we find evidence of a segregation effect, since mobility contraction is stronger in municipalities in which inequality is higher and for those where individuals have lower income per capita. Our Results highlight both the social costs of lockdown and a challenge of unprecedented intensity: On the one hand, the crisis is inducing a sharp reduction of fiscal revenues for both national and local governments; on the other hand, a significant fiscal effort is needed to sustain the most fragile individuals and to mitigate the increase in poverty and inequality induced by the lockdown.

Keywords: COVID-19 | economic segregation | human mobility | national lockdown

Giovanni Bonaccorsi, Francesco Pierri, Matteo Cinelli, Andrea Flori, Alessandro Galeazzi, Francesco Porcelli, Ana Lucia Schmidt, Carlo Michele Valensise, Antonio Scala, Walter Quattrociocchi & Fabio Pammolli

**Significance:** This paper presents a large-scale analysis of the impact of lockdown measures introduced in response to the spread of novel coronavirus disease 2019 (COVID-19) on socioeconomic conditions of Italian citizens. We leverage a massive near-real-time dataset of human mobility and we model mobility restrictions as an exogenous shock to the economy, similar to a natural disaster. We find that lockdown measures have a twofold effect: First, their impact on mobility is stronger in municipalities with higher fiscal capacity; second, they induce a segregation effect: mobility contraction is stronger in municipalities where inequality is higher and income per capita is lower. We highlight the necessity of fiscal measures that account for these effects, targeting poverty and inequality mitigation.

## BRETT 2020

Tobias S. Brett & Pejman Rohani, *Dynamical footprints enable detection of disease emergence*. [PLoS Biology 18 \(2020\), e3000697](#). DOI:10.5281/zenodo.3713381.

Developing methods for anticipating the emergence or reemergence of infectious diseases is both important and timely; however, traditional model-based approaches are stymied by uncertainty surrounding the underlying drivers. Here, we demonstrate an operational, mechanismagnostic detection algorithm for disease (re-)emergence based on early warning signals (EWSs) derived from the theory of critical slowing down. Specifically, we used computer simulations to train a supervised learning algorithm to detect the dynamical footprints of (re-)emergence present in epidemiological data. Our algorithm was then challenged to forecast the slowly manifesting, spatially replicated reemergence of mumps in England in the mid-2000s and pertussis post-1980 in the United States. Our method successfully anticipated mumps reemergence 4 years in advance, during which time mitigation efforts could have been implemented. From 1980 onwards, our model identified resurgent states with increasing accuracy, leading to reliable classification starting in 1992. Additionally, we successfully applied the detection algorithm to 2 vector-transmitted case studies, namely, outbreaks of dengue serotypes in Puerto Rico and a rapidly unfolding outbreak of plague in 2017 in Madagascar. Taken together, these findings illustrate the power of theoretically informed machine learning techniques to develop early warning systems for the (re-)emergence of infectious diseases.

## DEHNING 2020

Jonas Dehning et al., *Inferring change points in the spread of COVID-19 reveals the effectiveness of interventions*. [science 369 \(2020\), 160](#). DOI:10.1126/science.abb9789.

[s369-0160-Supplement.pdf](#)

As coronavirus disease 2019 (COVID-19) is rapidly spreading across the globe, short-term modeling forecasts provide time-critical information for decisions on containment and mitigation strategies. A major challenge for short-term forecasts is the assessment of key epidemiological parameters and how they change when first interventions show an effect. By combining an established epidemiological model with Bayesian inference, we analyzed the time dependence of the effective growth rate of new infections. Focusing on COVID-19 spread in Germany, we detected change points in the effective growth rate that correlate well with the times of publicly announced interventions. Thereby, we could quantify the effect of interventions and incorporate the corresponding change points into forecasts of future scenarios and case numbers. Our code is freely available and can be readily adapted to any country or region.

Jonas Dehning, Johannes Zierenberg, F. Paul Spitzner, Michael Wibral, Joao Pinheiro Neto, Michael Wilczek & Viola Priesemann

#### SALJE 2020

Henrik Salje, Cécile Tran Kiem & Simon Cauchemez et al., *Estimating the burden of SARS-CoV-2 in France*. *science* **369** (2020), 208–211.

[DOI:10.1126/science.abc3517](https://doi.org/10.1126/science.abc3517).

[s369-0208-Supplement.pdf](#)

France has been heavily affected by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic and went into lockdown on 17 March 2020. Using models applied to hospital and death data, we estimate the impact of the lockdown and current population immunity. We find that 2.9% of infected individuals are hospitalized and 0.5% of those infected die (95% credible interval: 0.3 to 0.9%), ranging from 0.001% in those under 20 years of age to 8.3% in those 80 years of age or older. Across all ages, men are more likely to be hospitalized, enter intensive care, and die than women. The lockdown reduced the reproductive number from 2.90 to 0.67 (77% reduction). By 11 May 2020, when interventions are scheduled to be eased, we project that 3.5 million people (range: 2.1 million to 6.0 million), or 5.3% of the population (range: 3.3 to 9.3%), will have been infected. Population immunity appears to be insufficient to avoid a second wave if all control measures are released at the end of the lockdown.

Henrik Salje, Cécile Tran Kiem, Noémie Lefrancq, Noémie Courtejoie, Paolo Bosetti, Juliette Paireau, Alessio Andronico, Nathanaël Hozé, Jehanne Richet, Claire-Lise Dubost, Yann Le Strat, Justin Lessler, Daniel Levy-Bruhl, Arnaud Fontanet, Lulla Opatowski, Pierre-Yves Boelle & Simon Cauchemez

#### ZHANG 2020

Renyi Zhang, Yixin Li, Annie L. Zhang, Yuan Wang & Mario J. Molina, *Identifying airborne transmission as the dominant route for the spread of COVID-19*. *PNAS* **117** (2020), 14857–14863.

[DOI:10.1073/pnas.2009637117](https://doi.org/10.1073/pnas.2009637117).

[pnas117-14857-Supplement.pdf](#)

Various mitigation measures have been implemented to fight the coronavirus disease 2019 (COVID-19) pandemic, including widely adopted social distancing and mandated face covering. However, assessing the effectiveness of those intervention practices hinges on the understanding of virus transmission, which remains uncertain. Here we show that airborne transmission is highly virulent and represents the dominant route to spread the disease. By analyzing the trend and mitigation measures in Wuhan, China, Italy, and New York City, from January 23 to May 9, 2020, we illustrate that the impacts of mitigation measures are discernable from the trends of the pandemic. Our analysis reveals that the difference with and without mandated face covering represents the determinant in shaping the pandemic trends in the three epicenters. This protective measure alone significantly reduced the number of infections, that is, by over 78,000 in Italy from April 6 to May 9 and over 66,000 in New York City from April 17 to May 9. Other mitigation measures, such as social distancing implemented in the United States, are insufficient by themselves in protecting the public. We conclude that wearing of face masks in public corresponds to the most effective means to prevent interhuman transmission, and this inexpensive practice, in conjunction with simultaneous social distancing, quarantine, and contact tracing, represents the most likely fighting opportunity to stop the COVID-19 pandemic. Our work also Highlights the fact that sound science is essential in decision-making for the current and future public health pandemics.

Keywords: COVID-19 | virus | aerosol | public health | pandemic

Significance: We have elucidated the transmission pathways of coronavirus disease 2019 (COVID-19) by analyzing the trend and mitigation measures in the three epicenters. Our results show that the airborne transmission route is highly virulent and dominant for the spread of COVID-19. The mitigation measures are discernable from the trends of the pandemic. Our analysis reveals that the difference with and without mandated face covering represents the determinant in shaping the trends of the pandemic. This protective measure significantly reduces the number of infections. Other mitigation measures, such as social distancing implemented in the United States, are insufficient by themselves in protecting the public. Our work also Highlights the necessity that sound science is essential in decision-making for the current and future public health pandemics.

## Amerika

WADE 2020

Lizzie Wade, *Polynesians, Native Americans met and mingled long ago*. [science](#) **369** (2020), 128.

## Bibel

LEVIN 2012

Yigal Levin, *Did Pharaoh Sheshonq Attack Jerusalem?* [Biblical Archaeology Review](#) **38** (2012), iv, 43–45, 48–52.

While there are many uncertainties, most scholars agree that Sheshonq's campaign as reflected in the Bubastite Portal and the campaign of Shishak as mentioned in the Bible are one and the same. Sheshonq's campaign in Israel and Judah brought an end to the many architectural, military and political achievements of the United Monarchy of David and Solomon and ushered in a new age that of the nation divided.

LIPOVSKY 2012

Igor P. Lipovsky, *Early Israelites: Two Peoples, One History, Rediscovery of the Origins of Ancient Israel*. (Washington 2019).

MARGALIT 2020

Ruth Margalit, *Built on Sand, In Search of King David's Lost Empire*. [New Yorker](#) **2020**, June 22.

The Biblical ruler's story has been told for millennia. Archeologists are still fighting over whether it's true.

But there are also examples throughout history of complex nomadic societies. Just look at Genghis Khan, Ben-Yosef argued. If archeology nearly missed the Edomite kingdom, what other ancient kingdom might it be missing? Ben-Yosef believes that the Edomite kingdom may not have been solely responsible for the prosperous copper trade: David and Solomon may have presided over it. How else to explain the boom in industry during the tenth century B.C.? "The scale of production tells us that there was something bigger than a few tribes here," he said. To view David as a marginal Bedouin sheikh would be a mistake, Ben-Yosef thinks. So would holding our breath for signs of his lavish kingdom. "If he came from a nomadic background, it doesn't make sense that the first thing he would do is build a big stone palace," Ben-Yosef said. "Why would he?"

PHILIPPSON 2018

WALTER HOMOLKA, HANNA LISS & RÜDIGER LIWAK  
(Hrsg.), *Die Schriften (hebräisch – deutsch), in der Übersetzung von  
Rabbiner Ludwig Philippson.* (Darmstadt 2018).

## Energie

COOKE 2020

Michael W. Cooke, Adrian Botti, Dorian Zok, Georg Steinhauser &  
Kurt R. Ungar, *Identification of a chemical fingerprint linking the  
undeclared 2017 release of  $^{106}\text{Ru}$  to advanced nuclear fuel reprocessing.*  
[PNAS 117 \(2020\), 14703–14711.](#)

[pnas117-14703-Supplement.pdf](#)

The undeclared release and subsequent detection of ruthenium-106 ( $^{106}\text{Ru}$ ) across Europe from late September to early October of 2017 prompted an international effort to ascertain the circumstances of the event. While dispersion modeling, corroborated by ground deposition measurements, has narrowed possible locations of origin, there has been a lack of direct empirical evidence to address the nature of the release. This is due to the absence of radiological and chemical signatures in the sample matrices, considering that such signatures encode the history and circumstances of the radioactive contaminant. In limiting cases such as this, we herein introduce the use of selected chemical transformations to elucidate the chemical nature of a radioactive contaminant as part of a nuclear forensic investigation. Using established ruthenium polypyridyl chemistry, we have shown that a small percentage ( $1.2 \pm 0.4\%$ ) of the radioactive  $^{106}\text{Ru}$  contaminant exists in a polychlorinated Ru(III) form, partly or entirely as  $^{106}\text{RuCl}_3$ , while 20% is both insoluble and chemically inert, consistent with the occurrence of  $\text{RuO}_2$ , the thermodynamic endpoint of the volatile  $\text{RuO}_4$ . Together, these findings present a clear signature for nuclear fuel reprocessing activity, specifically the reductive trapping of the volatile and highly reactive  $\text{RuO}_4$ , as the origin of the release. Considering that the previously established  $^{103}\text{Ru}:$  $^{106}\text{Ru}$  ratio indicates that the spent fuel was unusually young with respect to typical reprocessing protocol, it is likely that this exothermic trapping process proved to be a tipping point for an already turbulent mixture, leading to an abrupt and uncontrolled release.

**Keywords:** ruthenium | polypyridyl complex | radiochemistry | nuclear forensics

**Significance:** In the fall of 2017, a massive, undeclared release of  $^{106}\text{Ru}$  occurred that was detected across Eurasia. To conclusively address the nature of the release, we have used carefully selected and established chemical transformations to reveal a chemical fingerprint for the  $^{106}\text{Ru}$  contaminant that is uniquely consistent with specific methodology employed in the reprocessing of spent nuclear fuel. In view of international attention and investigation to date, this chemical fingerprint is the first direct evidence to this effect. This work serves, by example, as a potentially valuable addition to the field of nuclear forensics, considering that it is the only means to extract historical information from a radiopure contaminant in the absence of stable elemental anomalies.

## Islam

AHMAD 2019

*Al-Qur'ān Al-Karīm, Übersetzt von Muhammad Ibn Ahmad Ibn Rasoul, farbkodiert von Merdan Gunes.* (Köln 2019).

HENNING 1998

*Der Koran arabisch–deutsch, Aus dem Arabischen von Max Henning und Murad Wilfried Hoffmann.* (İstanbul <sup>3</sup>2016).

HENNING 2010

*Der Koran, aus dem Arabischen übertragen von Max Henning.* (Hamburg <sup>11</sup>2020).

## Jungpaläolithikum

KACKI 2020

Sacha Kacki, Erik Trinkaus, Eline M. J. Schotsmans, Vitale S. Sparacello & Sébastien Villotte et al., *Complex mortuary dynamics in the Upper Paleolithic of the decorated Grotte de Cussac, France.* [PNAS 117 \(2020\), 14851–14856.](#)

[pnas117-14851-Supplement.pdf](#)

The Mid-Upper Paleolithic (Gravettian) karstic Grotte de Cussac (France) contains two areas of human remains in the context of abundant (and spectacular) parietal engravings. The first area (loci 1 and 2) includes the skeleton of a young adult male in a bear nest, rearranged by postdecomposition inundation, and the variably fragmentary remains of at least two individuals distributed across two bear nests, sorted anatomically and with most of the elements constrained to one side of one nest. The second area (locus 3) retains remains of two adults and an adolescent, in upper hollows and variably distributed down the slope, largely segregated into upper versus lower body groups. The only decoration associated with the human remains is red pigment on some of the bones or underlying sediment. The human remains indicate variable nonnatural deposition and manipulation of human bodies, body portions, and skeletal elements of at least six individuals. Moreover, Cussac is unusual in the association of these remains with exceptional parietal art. The complex Cussac mortuary pattern joins growing evidence from other Gravettian sites of variable treatment of individuals after death, within and across sites, in terms of formal deposition of the body versus postmortem manipulation versus surface abandonment. It provides a window onto the social diversity and the complex interactions of the living and the dead among these successful Late Pleistocene foragers.

**Keywords:** Paleolithic foragers | funerary behaviors | archeoethanatology | decorated cave

Sacha Kacki, Erik Trinkaus, Eline M. J. Schotsmans, Patrice Courtaud, Irene Dori, Bruno Dutailly, Pierre Guyomarc'h, Pascal Mora, Vitale S. Sparacello & Sébastien Villotte

**Significance:** Gravettian mortuary practices provide a key perspective on social complexity during the Upper Paleolithic. Such inferences have been drawn mostly from the formal burials relatively abundant for this period. Here we present the bioanthropological study of Grotte de Cussac, a decorated cave with Gravettian human remains deposited on the floor. These bone accumulations correspond to several forms of deposition (a whole body, body parts on the surface, and dry bones in bear nests), plus displacement and removal of elements that indicate diverse and complex mortuary behaviors. The exceptional preservation during millennia of these surficial deposits illustrates steps of a mortuary landscape that are beyond reach in more usual Upper Paleolithic burial sites.



## Klima

### BABIN 2020

Marcel Babin, *Climate change tweaks Arctic marine ecosystems*. [science](#) **369** (2020), 137–138.

Nutrient input might enhance productivity in the Arctic Ocean of the future.

### LEWIS 2020

K. M. Lewis, G. L. van Dijken & K. R. Arrigo, *Changes in phytoplankton concentration now drive increased Arctic Ocean primary production*. [science](#) **369** (2020), 198–202.

s369-0198-Supplement.pdf

Historically, sea ice loss in the Arctic Ocean has promoted increased phytoplankton primary production because of the greater open water area and a longer growing season. However, debate remains about whether primary production will continue to rise should sea ice decline further. Using an ocean color algorithm parameterized for the Arctic Ocean, we show that primary production increased by 57% between 1998 and 2018. Surprisingly, whereas increases were due to widespread sea ice loss during the first decade, the subsequent rise in primary production was driven primarily by increased phytoplankton biomass, which was likely sustained by an influx of new nutrients. This suggests a future Arctic Ocean that can support higher trophic-level production and additional carbon export.

### MCCONNELL 2020

Joseph R. McConnell, Michael Sigl, Gill Plunkett, Andrea Burke, Woon Mi Kim, Christoph C. Raible, Andrew I. Wilson, Joseph , *Extreme climate after massive eruption of Alaska’s Okmok volcano in 43 BCE and effects on the late Roman Republic and Ptolemaic Kingdom*. [PNAS](#) **117** (2020), 15443–15449.

pnas117-15443-Supplement1.pdf, pnas117-15443-Supplement2.xlsx, pnas117-15443-Supplement3.xlsx

The assassination of Julius Caesar in 44 BCE triggered a power struggle that ultimately ended the Roman Republic and, eventually, the Ptolemaic Kingdom, leading to the rise of the Roman Empire. Climate proxies and written documents indicate that this struggle occurred during a period of unusually inclement weather, famine, and disease in the Mediterranean region; historians have previously speculated that a large volcanic eruption of unknown origin was the most likely cause. Here we show using well-dated volcanic fallout records in six Arctic ice cores that one of the largest volcanic eruptions of the past 2,500 y occurred in early 43 BCE, with distinct geochemistry of tephra deposited during the event identifying the Okmok volcano in Alaska as the source. Climate proxy records show that 43 and 42 BCE were among the coldest years of recent millennia in the Northern Hemisphere at the start of one of the coldest decades. Earth system modeling suggests that radiative forcing from this massive, high-latitude eruption led to pronounced changes in hydroclimate, including seasonal temperatures in specific Mediterranean regions as much as 7 °C below normal during the 2 y period following the eruption and unusually wet conditions. While it is difficult to establish direct causal linkages to thinly documented historical events, the wet and very cold conditions from this massive eruption on the opposite side of Earth probably resulted in crop failures, famine, and disease, exacerbating social unrest and contributing to political realignments throughout the Mediterranean region at this critical juncture of Western civilization.

Keywords: ice core | volcano | Okmok | Rome | climate forcing

Joseph R. McConnell, Michael Sigl, Gill Plunkett, Andrea Burke, Woon Mi Kim, Christoph C. Raible, Andrew I. Wilson, Joseph G. Manning, Francis Ludlow, Nathan J. Chellman, Helen M. Innes, Zhen Yang, Jessica F. Larsen, Janet R. Schaefer, Sepp Kipfstuhl, Seyedhamidreza Mojtabavi, Frank Wilhelms, Thomas Opel, Hanno Meyer & Jørgen Peder Steffensen

**Significance:** The first century BCE fall of the Roman Republic and Ptolemaic Kingdom and subsequent rise of the Roman Empire were among the most important political transitions in the history of Western civilization. Volcanic fallout in well-dated Arctic ice core records, climate proxies, and Earth system modeling show that this transition occurred during an extreme cold period resulting from a massive eruption of Alaska’s Okmok volcano early in 43 BCE. Written sources describe unusual climate, crop failures, famine, disease, and unrest in the Mediterranean immediately following the eruption—suggesting significant vulnerability to hydroclimatic shocks in otherwise sophisticated and powerful ancient states. Such shocks must be seen as having played a role in the historical developments for which the period is famed.

## MOORE 2020

Andrew M. T. Moore, James P. Kennett, William M. Napier, Ted E. Bunch, James C. Weaver, Malcolm Lecompte, A. Victor Ade, *Evidence of cosmic impact at Abu Hureyra, Syria at the Younger Dryas Onset ( $\approx 12.8$  ka), High-temperature melting at  $> 2200$  °C. [Scientific Reports](#) **10** (2020), 4185. DOI:10.1038/s41598-020-60867-w.*

SciRep10-04185-Supplement.pdf

At Abu Hureyra (AH), Syria, the 12,800-year-old Younger Dryas boundary layer (YDB) contains peak abundances in meltglass, nanodiamonds, microspherules, and charcoal. AH meltglass comprises 1.6 wt. % of bulk sediment, and crossed polarizers indicate that the meltglass is isotropic. High YDB concentrations of iridium, platinum, nickel, and cobalt suggest mixing of melted local sediment with small quantities of meteoritic material. Approximately 40 % of AH glass display carbon-infused, siliceous plant imprints that laboratory experiments show formed at a minimum of 1200°–1300 °C; however, reflectance-inferred temperatures for the encapsulated carbon were lower by up to 1000 °C. Alternately, melted grains of quartz, chromferide, and magnetite in AH glass suggest exposure to minimum temperatures of 1720 °C ranging to  $>2200$  °C. This argues against formation of AH meltglass in thatched hut fires at 1100°–1200 °C, and low values of remanent magnetism indicate the meltglass was not created by lightning. Low meltglass water content (0.02–0.05 % H<sub>2</sub>O) is consistent with a formation process similar to that of tektites and inconsistent with volcanism and anthropogenesis. The wide range of evidence supports the hypothesis that a cosmic event occurred at Abu Hureyra  $\approx 12,800$  years ago, coeval with impacts that deposited high-temperature meltglass, melted microspherules, and/or platinum at other YDB sites on four continents.

Andrew M. T. Moore, James P. Kennett, William M. Napier, Ted E. Bunch, James C. Weaver, Malcolm Lecompte, A. Victor Adedeji, Paul Hackley, Gunther Kletetschka, Robert E. Hermes, James H. Wittke, Joshua J. Razink, Michael W. Gaultois & Allen West



## Kultur

TOWNSEND 2020

Cathryn Townsend, Athena Aktipis, Daniel Balliet & Lee Cronk, *Generosity among the Ik of Uganda*. *Evolutionary Human Sciences* **2** (2020), e23. DOI:10.1017/ehs.2020.22.

According to Turnbull's 1972 ethnography *The Mountain People*, the Ik of Uganda had a culture of selfishness that made them uncooperative. His claims contrast with two widely accepted principles in evolutionary biology, that humans cooperate on larger scales than other species and that culture is an important facilitator of such cooperation. We use recently collected data to examine Ik culture and its influence on Ik behaviour. Turnbull's observations of selfishness were not necessarily inaccurate but they occurred during a severe famine. Cooperation re-emerged when people once again had enough resources to share. Accordingly, Ik donations in unframed Dictator Games are on par with average donations in Dictator Games played by people around the world. Furthermore, Ik culture includes traits that encourage sharing with those in need and a belief in supernatural punishment of selfishness. When these traits are used to frame Dictator Games, the average amounts given by Ik players increase. Turnbull's claim that the Ik have a culture of selfishness can be rejected. Cooperative norms are resilient, and the consensus among scholars that humans are remarkably cooperative and that human cooperation is supported by culture can remain intact.

Keywords: dictator game; sharing; scarcity; famine; generosity; cooperation

## Kupfer

BERGER 2020

D. Berger, G. Brüggemann & E. Pernicka, *Metallurgical investigation of tin rings from grave no. 50*. In: MICHAL ERNÉE & MICHAELA LANGOVÁ ET AL. (Hrsg.), *Mikulovice, Early Bronze Age Cemetery on the Amber Road*. Památky archeologické Supplementum 21 (Prague 2020), 409–411.

This reveals how difficult it is to track the specific tin source using the tin isotope systematics alone. However, other parameters such as the lead isotope and trace element composition can help to set further limits for potential tin sources (Berger et al. 2019). We currently continue to determine lead isotope ratios and trace element compositions, and like to present the Results in a forthcoming paper complemented with data of bronzes from the same grave and other burials of the Mikulovice necropolis.

## Mathematik

LOH 2019

Po-Shen Loh, *A Simple Proof of the Quadratic Formula*. *arXiv* (2019), 1910.06709. <<http://arxiv.org/pdf/1910.06709>>.

This article provides a simple proof of the quadratic formula, which also produces an efficient and natural method for solving general quadratic equations. The derivation is computationally light and conceptually natural, and has the potential to demystify quadratic equations for students worldwide.

## Methoden

HAMMANN 2020

Simon Hammann, David J. Scurr, Morgan R. Alexander & Lucy J. E. Cramp, *Mechanisms of lipid preservation in archaeological clay ceramics revealed by mass spectrometry imaging*. *PNAS* **117** (2020), 14688–14693.

[pnas117-14688-Supplement.pdf](#)

Traces of lipids, absorbed and preserved for millennia within the inorganic matrix of ceramic vessels, act as molecular fossils and provide manifold information about past people's subsistence, diet, and rituals. It is widely assumed that lipids become preserved after adsorption into nano- to micrometer-sized pores, but to this day the distribution of these lipids in the ceramics was virtually unknown, which severely limits our understanding about the process of lipid preservation. Here we use secondary ion mass spectrometry (SIMS) imaging for direct in situ analysis of lipids absorbed in 700- to 2,000-y-old archaeological pottery. After sectioning from larger sherds, wall cross-sections of smaller fragments were used for SIMS analysis. Lipids were found in relatively large zones of 5- to 400- $\mu\text{m}$  diameter, which does not support the notion of absorption only into individual nanometer-scale pores but indicates that more macroscopic structures in the ceramics are involved in lipid preservation as well. Furthermore, lipids were found concentrated on calcium carbonate inclusions in the ceramics, which suggests that precipitation of fatty acids as calcium salts is an important aspect of lipid preservation in archaeological samples. This has important implications for analytical Methods based on extraction of lipids from archaeological ceramics and needs to be considered to maximize the yield and available information from each unique sample.

**Keywords:** lipid | archaeology | mass spectrometry imaging | SIMS

**Significance:** Lipids, preserved in archaeological ceramics, offer unique insights into past people's diets and cultural practices. Yet, the fundamental question of how lipids are preserved for millennia is not clear. This study describes the direct visualization of lipids in wall cross-sections of archaeological potsherds using mass spectrometry imaging. Lipids were distributed unevenly in zones of  $>200\text{-}\mu\text{m}$  size, indicating that macroscopic structures and properties, and not only small pores, facilitate lipid preservation. We also show the formation of calcium fatty acid salts as an additional aspect of lipid preservation. These findings have important implications for the selection of appropriate Methods for lipid analysis in potsherds and show that the analysis of lipid distribution patterns could improve and refine interpretations.

## Mittelpaläolithikum

MAFESSONI 2020

Fabrizio Mafessoni, Andrey I. Krivoschapkin, Anatoly P. Derevianko, Janet Kelso, Kay Prüfer & Svante Pääbo et al., *A high-coverage Neandertal genome from Chagyrskaya Cave*. *PNAS* **117** (2020), 15132–15136.

[pnas117-15132-Supplement.pdf](#)

We sequenced the genome of a Neandertal from Chagyrskaya Cave in the Altai Mountains, Russia, to 27-fold genomic coverage. We show that this Neandertal was a female and that she was more related to Neandertals in western Eurasia [Prüfer et al., *Science* 358, 655–658 (2017); Hajdinjak et al., *Nature* 555, 652–656 (2018)] than to Neandertals who lived earlier in Denisova Cave [Prüfer et al.,

Nature 505, 43–49 (2014)], which is located about 100 km away. About 12.9% of the Chagyrskaya genome is spanned by homozygous regions that are between 2.5 and 10 centiMorgans (cM) long. This is consistent with the fact that Siberian Neandertals lived in relatively isolated populations of less than 60 individuals. In contrast, a Neandertal from Europe, a Denisovan from the Altai Mountains, and ancient modern humans seem to have lived in populations of larger sizes. The availability of three Neandertal genomes of high quality allows a view of genetic features that were unique to Neandertals and that are likely to have been at high frequency among them. We find that genes highly expressed in the striatum in the basal ganglia of the brain carry more aminoacidchanging substitutions than genes expressed elsewhere in the brain, suggesting that the striatum may have evolved unique functions in Neandertals.

**Keywords:** genetics | Neandertals | human evolution | genome

Fabrizio Mafessoni, Steffi Grote, Cesare de Filippo, Viviane Slon, Kseniya A. Kolobova, Bence Viola, Sergey V. Markin, Manjusha Chintalapati, Stephane Peyrégne, Laurits Skov, Pontus Skoglund, Andrey I. Krivoschapkin, Anatoly P. Derevianko, Matthias Meyer, Janet Kelso, Benjamin Peter, Kay Prüfer & Svante Pääbo

**Significance:** We present the third high-quality genome to be determined from a Neandertal. Patterns of variation in the genome suggest that her ancestors lived in relatively isolated populations of less than 60 individuals. When we analyze this genome together with two previously sequenced Neandertal genomes, we find that genes expressed in the striatum of the brain may have changed especially much, suggesting that the striatum may have evolved unique functions in Neandertals.