

## References

### Afrika

CAMERON 2019

Michelle E. Cameron, *The Riet River sites, Positioning regional diversity in the introduction of domesticated livestock to southern Africa. Journal of Archaeological Science: Reports* **23** (2019), 72–79.

The introduction of domesticated livestock to southernmost Africa influenced both human-environment interactions and human-animal relations. This process did not occur in a uniform manner across the southern Cape region. Regional studies may contribute to broader narratives regarding this process, which occurred toward the end of the Later Stone Age. Archaeological sites located in the semiarid central interior of southern Africa, particularly along the course of the Riet River (approximately 1000–200 BP), provide some insight into this transition. To investigate the introduction of domesticated livestock in the Riet River region, a variety of archaeological Methods have been applied. Analyses of local stone-walled settlement areas and enclosures indicate changing landscape use and changing relations with animals. Stable isotopic evidence from human skeletal remains suggests high reliance on wild fauna rather than domesticated livestock, indicating some overlap with foraging lifeways. Zooarchaeological evidence, however, requires further probing. This paper will outline the unique Riet River context within the broader southern African Later Stone Age narrative and will outline how zooarchaeological Methods may contribute to our theoretical understanding of how the introduction of domesticated livestock impacted human groups in southern Africa.

Keywords: Later Stone Age | Southern Africa | Herding | Domesticated animals | Faunal analyses

### Aktuell

BOTSYUN 2019

Svetlana Botsyun, Pierre Sepulchre, Yannick Donnadiou, Camille Risi, Alexis Licht & Jeremy K. Caves Rügenstein, *Revised paleoaltimetry data show low Tibetan Plateau elevation during the Eocene. science* **363** (2019), 946.

s363-0946-Supplement.pdf

Paleotopographic reconstructions of the Tibetan Plateau based on stable isotope paleoaltimetry methods conclude that most of the Plateau's current elevation was already reached by the Eocene,  $\approx 40$  million years ago. However, changes in atmospheric and hydrological dynamics affect oxygen stable isotopes in precipitation and may thus bias such reconstructions. We used an isotope-equipped general circulation model to assess the influence of changing Eocene paleogeography and climate on paleoelevation estimates. Our simulations indicate that stable isotope paleoaltimetry methods are not applicable in Eocene Asia because of a combination of increased convective precipitation, mixture of air masses, and widespread aridity. Rather, a model-data comparison suggests that the Tibetan Plateau only reached low to moderate (less than 3000 meters) elevations during the Eocene, reconciling oxygen isotope data with other proxies.

## CAZORLA 2019

Claudio Cazorla, *Refrigeration based on plastic crystals*. [nature](#) **567** (2019), 470–471.

Materials called plastic crystals have been found to undergo huge temperature changes when subjected to small pressures near room temperature. Such materials could form the basis of future refrigeration technologies.

Given their organic nature, they have relatively low melting points (typically about 300–400 K)<sup>8</sup>, which is not desirable for refrigeration applications. In addition, the properties that make plastic crystals highly deformable mean that these materials lack the mechanical resilience to endure many refrigeration cycles. Perhaps most importantly, hysteresis and phase-co existence effects are likely to weaken the cooling performance of plastic crystals.

## VAN HINSBERGEN 2019

Douwe J. J. van Hinsbergen & Lydian M. Boschman, *How high were these mountains?* [science](#) **363** (2019), 928–929.

An iterative approach is needed to constrain the past elevation of mountain belts.

Botsyun et al.’s work shows that estimating paleoaltimetry requires iterative tuning with paleoclimate models, in which uncertainties in paleogeography influence the outcome. This finding means that modeling climate dynamics requires even more computer power than previously realized. Furthermore, it opens opportunities for cross-disciplinary work by geologists, biologists, physicists, statisticians, and computer scientists. This work is needed to understand paleoclimate evolution as a proxy for the future effects of human-induced climate change. It is also crucial for comprehending biodiversity and the fundamental workings of our planet’s interior, fields for which knowledge of paleoaltimetry is essential.

## HUTHOFF 2019

Hendrik Huthoff, *The courage to leave*. [science](#) **363** (2019), 898.

“I walked out of my first Ph.D. project!” I exclaimed. I was just a few months into a new job as manager of a graduate school, sitting in my first doctoral student recruitment board meeting. The faculty members and I were discussing the candidates we had interviewed. One hadn’t hidden the fact that she wished to leave her current Ph.D. position to join our program, and some of the faculty members worried this might be a bad sign, indicating a lack of commitment. I argued that such a decision is not taken lightly and, depending on the circumstances, can indicate strength of character rather than failure. I hadn’t planned to bring up my personal experience, but it felt like the right time.

## LI 2019

Bing Li et al., *Colossal barocaloric effects in plastic crystals*. [nature](#) **567** (2019), 506–510.

Bing Li, Yukinobu Kawakita, Seiko Ohira-Kawamura, Takeshi Sugahara, Hui Wang, Jingfan Wang, Yanna Chen, Saori I. Kawaguchi, Shogo Kawaguchi, Koji Ohara, Kuo Li, Dehong Yu, Richard Mole, Takanori Hattori, Tatsuya Kikuchi, Shin-ichiro Yano, Zhao Zhang, Zhe Zhang, Weijun Ren, Shangchao Lin, Osami Sakata, Kenji Nakajima & Zhidong Zhang

Refrigeration is of vital importance for modern society—for example, for food storage and air conditioning—and 25 to 30 per cent of the world’s electricity is consumed for refrigeration. Current refrigeration technology mostly involves the conventional vapour compression cycle, but the materials used in this technology

are of growing environmental concern because of their large global warming potential. As a promising alternative, refrigeration technologies based on solid-state caloric effects have been attracting attention in recent decades. However, their application is restricted by the limited performance of current caloric materials, owing to small isothermal entropy changes and large driving magnetic fields. Here we report colossal barocaloric effects (CBCEs) (barocaloric effects are cooling effects of pressure-induced phase transitions) in a class of disordered solids called plastic crystals. The obtained entropy changes in a representative plastic crystal, neopentylglycol, are about 389 joules per kilogram per kelvin near room temperature. Pressure-dependent neutron scattering measurements reveal that CBCEs in plastic crystals can be attributed to the combination of extensive molecular orientational disorder, giant compressibility and highly anharmonic lattice dynamics of these materials. Our study establishes the microscopic mechanism of CBCEs in plastic crystals and paves the way to next-generation solid-state refrigeration technologies.

#### REARDON 2019

Sara Reardon, *Universities spooked by Trump free-speech order*. [nature 567 \(2019\), 445–446](#).

US institutions must certify that they protect free speech to receive research funding.

Peter McPherson, president of the Association of Public and Land-Grant Universities in Washington DC, called the order “plainly unnecessary” in a statement. “Public universities are already bound by the First Amendment and work each day to defend and honor it,” he said. Although the text of the policy does not mention politics, Trump’s speeches and tweets have indicated that his action is intended to protect conservative voices, Hess says.

#### SANTOS-DÍAZ 2019

Stephanie Santos-Díaz, *When support becomes pressure*. [science 363 \(2019\), 1006](#).

“What is the biggest challenge of graduate school?” an undergrad asked the panel of graduate students at an event I helped organize last summer. “Not letting the support from my community turn into pressure,” one panelist responded. That answer might have surprised some, who probably expected to hear about experiments that didn’t work or trudging through literature reviews. But I understood exactly what she meant. The speaker was an AfricanAmerican woman. I am a member of an underrepresented minority group myself, pursuing a doctoral degree in chemistry, so her comment resonated with me. With my oral candidacy exam approaching, I needed to find a way to keep well-meaning support from adding to my stress.

#### SCHIERMEIER 2019

Quirin Schiermeier, *Ancient Antarctic ice holds record of Earth’s climate*. [nature 567 \(2019\), 442–443](#).

International team plans to extract column containing 1.5-million-year-old ice.

## Anthropologie

#### SIMPSON 2019

Scott W. Simpson, Naomi E. Levin, Jay Quade, Michael J. Rogers & Sileshi Semaw, *Ardipithecus ramidus postcrania from the Gona Project*

area, Afar Regional State, Ethiopia. [Journal of Human Evolution](#) **129** (2019), 1–45.

Functional analyses of the 4.4 Ma hominin *Ardipithecus ramidus* postcrania revealed a previously unknown and unpredicted locomotor pattern combining arboreal clambering and a form of terrestrial bipedality. To date, all of the fossil evidence of *Ar. ramidus* locomotion has been collected from the Aramis area of the Middle Awash Research Project in Ethiopia. Here, we present the results of an analysis of additional early Pliocene *Ar. ramidus* fossils from the Gona Project study area, Ethiopia, that includes a fragmentary but informative partial skeleton (GWM67/P2) and additional isolated manual remains. While we reinforce the original functional interpretations of *Ar. ramidus* of having a mixed locomotor adaptation of terrestrial bipedality and arboreal clambering, we broaden our understanding of the nature of its locomotor pattern by documenting better the function of the hip, ankle, and foot. The newly recovered fossils document a greater adaptation to bipedality in the *Ar. ramidus* ankle and hallux than previously recognized. In addition, a newly discovered scaphoid bone with a fusing os centrale provides further evidence about the nature of hominin hand evolution.

**Keywords:** *Ardipithecus ramidus* | Hominin | Gona | Ethiopia | Postcrania | Bipedality

## Bibel

GREER 2017

Jonathan S. Greer, *The Cult at Tel Dan, Aramean or Israelite?* In: ANGELIKA BERLEJUNG, AREN M. MAEIR & ANDREAS SCHÜLE (Hrsg.), *Wandering Arameans, Arameans Outside Syria – Textual and Archaeological Perspectives*. Leipziger Altorientalistische Studien 5 ([Wiesbaden 2017](#)), 3–18.

Thus to conclude, there are strong resonances between the archaeological remains from the temple complex at Tel Dan and the descriptions of Israelite religious practice contained in the priestly texts of the Hebrew Bible and these congruencies may be seen to strengthen the plausibility of envisioning a Yahwistic cult at the Danite central sanctuary. These correspondences alone, however, are not enough to make a claim of “uniquely Israelite” practice (with the possible exception of the Immadiyaw seal) in that the rituals and paraphernalia of the Israelite cult were likely very similar to those of Aramean, Phoenician, and other regional cults. It is the combination of these congruencies with the textual traditions contained within the Hebrew Bible that explicitly mention the foundation of a Yahwistic cult at this location and, perhaps more significantly, fail to denounce it as a shrine to any other deity – Hadad or otherwise – in any extant text. The latter point is especially salient when considered within an understanding of the polemical intent of the Deuteronomistic History, whatever its date or compositional history: if the Israelite historians could have denounced the cult at Dan as Aramean, they surely would have.

## Datierung

BOARETTO 2015

Elisabetta Boaretto, *Radiocarbon and the Archaeological Record, An Integrative Approach for Building an Absolute Chronology for the Late Bronze and Iron Ages of Israel*. [Radiocarbon](#) **57** (2015), 207–216.

The establishment of an absolute chronology for the Late Bronze and Iron Ages in the southern Levant would make it possible to use changes in material culture in order to study the impact of trade, dissemination of knowledge, and the impact of climate on historical processes. To achieve this, a detailed absolute chronology is needed for individual sites and on a regional scale with a resolution that can differentiate events within a century. To realize this challenging goal, only samples from well-established primary contexts ought to be studied. Such primary contexts (with “dating assemblages”) can be identified by combining macroscopic with microscopic observations. Chronological studies at the sites of Qubur el-Walaydah, Tel es-Safi, and in particular, Megiddo, demonstrate that high-resolution dating can be achieved, with very few outliers in the data sets. The major limitation on applying this approach is the fact that we are currently constrained to dating short-lived samples (charred seeds and olive pits) and collagen from bones. Thus, an immediate goal of radiocarbon research is to develop the ability to date other short-lived materials, such as organic material occluded in siliceous plant phytoliths, wood ash, and possibly organic residues preserved in pottery vessels.

#### BURGESS 2019

Seth Burgess, *Deciphering mass extinction triggers*. [science](#) **363** (2019), 815–816.

Improved radioisotope dates help to illuminate the causes of mass extinctions.

To better constrain what drove the K-Pg extinction, Sprain et al. and Schoene et al. apply radiogenic isotope dating to rocks from the Deccan Traps in India; these rocks are preserved remnants of the massive LIP emplaced roughly at the same time as the K-Pg extinction event. However, the two studies do not agree on the relative timing of LIP emplacement and extinction, whether the impact event and LIP are causally connected, and the relative importance of each event in triggering extinction.

#### DI MAIDA 2019

Gianpiero Di Maida, Marcello A. Mannino, Ben Krause-Kyora, Theis Zetner Trolle Jensen & Sahra Talamo, *Radiocarbon dating and isotope analysis on the purported Aurignacian skeletal remains from Fontana Nuova (Ragusa, Italy)*. [PLoS ONE](#) **14** (2019), e213173. DOI:10.1371/journal.pone.0213173.

Proving voyaging at sea by Palaeolithic humans is a difficult archaeological task, even for short distances. In the Mediterranean, a commonly accepted sea crossing is that from the Italian Peninsula to Sicily by anatomically modern humans, purportedly of the Aurignacian culture. This claim, however, was only supported by the typological attribution to the Aurignacian of the lithic industries from the insular site of Fontana Nuova. AMS radiocarbon dating undertaken as part of our research shows that the faunal remains, previously considered Aurignacian, actually date to the Holocene. Absolute dating on dentinal collagen also attributes the human teeth from the site to the early Holocene, although we were unable to obtain ancient DNA to evaluate their ancestry. Ten radiocarbon dates on human and other taxa are comprised between 9910–9700 cal. BP and 8600–8480 cal. BP, indicating that Fontana Nuova was occupied by Mesolithic and not Aurignacian hunter-gatherers. Only a new study of the lithic assemblage could establish if the material from Fontana Nuova is a mixed collection that includes both late Upper Palaeolithic (Epigravettian) and Mesolithic artefacts, as can be suggested by taking into account both the results of our study and of the most recent reinterpretation of the lithics. Nevertheless, this research suggests that the notion that

Aurignacian groups were present in Sicily should now be revised. Another outcome of our study is that we found that three specimens, attributed on grounds both of morphological and ZooMS identifications to *Cervus elaphus*, had  $\delta^{13}\text{C}$  values significantly higher than any available for such species in Europe.

#### SCHOENE 2019

Blair Schoene, Michael P. Eddy, Kyle M. Samperton, C. Brenhin Keller, Gerta Keller, Thierry Adatte & Syed F. R. Khadri, *U-Pb constraints on pulsed eruption of the Deccan Traps across the end-Cretaceous mass extinction*. [science 363 \(2019\), 862–866](#).

s363-0862-Supplement.pdf

Temporal correlation between some continental flood basalt eruptions and mass extinctions has been proposed to indicate causality, with eruptive volatile release driving environmental degradation and extinction. We tested this model for the Deccan Traps flood basalt province, which, along with the Chicxulub bolide impact, is implicated in the Cretaceous-Paleogene (K-Pg) extinction approximately 66 million years ago. We estimated Deccan eruption rates with uranium-lead (U-Pb) zircon geochronology and resolved four high-volume eruptive periods. According to this model, maximum eruption rates occurred before and after the K-Pg extinction, with one such pulse initiating tens of thousands of years prior to both the bolide impact and extinction. These findings support extinction models that incorporate both catastrophic events as drivers of environmental deterioration associated with the K-Pg extinction and its aftermath.

#### SPRAIN 2019

Courtney J. Sprain, Paul R. Renne, Loïc Vanderkluysen, Kanchan Pande, Stephen Self & Tushar Mittal, *The eruptive tempo of Deccan volcanism in relation to the Cretaceous-Paleogene boundary*. [science 363 \(2019\), 866–870](#).

s363-0866-Supplement1.pdf, s363-0866-Supplement2.xlsx

Late Cretaceous records of environmental change suggest that Deccan Traps (DT) volcanism contributed to the Cretaceous-Paleogene boundary (KPB) ecosystem crisis. However, testing this hypothesis requires identification of the KPB in the DT. We constrain the location of the KPB with high-precision argon-40/argon-39 data to be coincident with changes in the magmatic plumbing system. We also found that the DT did not erupt in three discrete large pulses and that >90% of DT volume erupted in <1 million years, with  $\approx 75\%$  emplaced post-KPB. Late Cretaceous records of climate change coincide temporally with the eruption of the smallest DT phases, suggesting that either the release of climate-modifying gases is not directly related to eruptive volume or DT volcanism was not the source of Late Cretaceous climate change.

## Energie

#### CHO 2019

Adrian Cho, *The Little Reactors That Could*. [science 363 \(2019\), 806–809](#).

Billed as safe and cheap, NuScale's small reactors aim to revive the ailing nuclear industry and help save a warming planet.

To succeed, NuScale will have to compete with cheap natural gas. The company aims to produce electricity at a total cost, including construction and operations,

of \$65 per megawatt-hour. That's about 20% higher than the current cost of energy from a gaspowered plant. However, Rosner says, "The price of gas isn't going to stay low forever." Countries also could put a price on carbon emissions, which would drive up the cost of fossil-fuel power. In fact, a September 2018 report from MIT indicated that a carbon tax could make nuclear competitive with gas.

## Grabung

LÜNING 2012

Jens Lüning, *Zwei Gründergräber in der ältestbandkeramischen Siedlung Schwanfeld, Ldkr. Schweinfurt, Unterfranken*. In: WULF RAECK & DIRK STEUERNAGEL (Hrsg.), *Das Gebaute und das Gedachte, Siedlungsform, Architektur und Gesellschaft in prähistorischen und antiken Kulturen*. Frankfurter Archäologische Schriften 21 (Bonn 2012), 99–114.

## Isotope

BEN-YOSEF 2019

Erez Ben-Yosef, *Archaeological science brightens Mediterranean dark age*. *PNAS* **116** (2019), 5843–5845.

Controversies over the application of this method in the archaeology of the eastern Mediterranean, especially with regard to mapping trade connections in the Late Bronze Age based on copper ingots, were part of one of the most contentious debates in archaeological science (17), leading to a more careful approach that heeds the various methodological caveats and avoids the decisive tone previously used for reporting ostensible positive sourcing.

## Keramik

DENIS 2019

Solène Denis, Erik Gjesfjeld & Luc Moreau, *Post-Linear Pottery cultural boundary and repopulation of the German Rhineland, Revisiting the Western contacts hypothesis*. *Journal of Archaeological Science: Reports* **23** (2019), 946–952.

JASRep023-0946-Supplement1.pdf, JASRep023-0946-Supplement2.pdf

The lack of consensus surrounding the macroscopic determination of high-quality black flint discovered at the Aldenhoven Plateau sites (Rhineland, North-Western Germany) from the beginning of the Middle Neolithic has far-reaching consequences for the anthropological understanding of the socio-cultural dynamics involved in the neolithization of North-Western Europe. This flint has been assigned to Western Belgian 'Obourg' flint type and is used as a key indicator of strong links between populations from West Belgium (Mons Basin) and the German Rhineland at the beginning of the 5th millennium BC. Here, we present an integrated study of this flint using geochemical and lithic technological approaches. This work rules out attribution of the analysed flint artefacts to the Upper Cretaceous flint sources of the Mons Basin; however, the exact origin of the black flint used in the Rhineland remains unanswered. Our results do not support the hypothesis of intensive contact between populations from West Belgium and the



German Rhineland and Highlights the urgent need for further combined petrographic and geochemical analyses in the region, particularly on geological samples, in order to build up an extensive and reliable comparative reference collection.

Keywords: Neolithic | Flint sourcing | LA-ICP-MS | Lithic technology | Technical traditions | Post-Linear Pottery cultures | North-western Europe

## KMOŠEK 2018

Jiří Kmošek, Martin Odler, Marek Fikrle & Yulia V. Kochergina, *Invisible connections. Early Dynastic and Old Kingdom Egyptian metalwork in the Egyptian Museum of Leipzig University*. [Journal of Archaeological Science](#) **96** (2018), 191–207.

An assemblage of ancient Egyptian metalwork from the Early Dynastic and Old Kingdom periods, currently in the Egyptian Museum of Leipzig University (Germany), has been studied using a wide range of available archaeometallurgical Methods. The 3rd millennium BC Egyptian copper metallurgy is known only superficially until now. The data are interpreted in the framework of the known and reconstructed distribution networks of ancient Egyptian society. The production technology of the objects has been examined. The lead isotope analyses have made it possible to discuss the origin of the ore used for the production of Old Kingdom metalwork for the first time. A rather surprising presence in the Early Dynastic assemblage of object similar in isotopic ratios to Anatolian Early Bronze Age metalwork is discussed.

Keywords: Early Dynastic Egypt | Old Kingdom Egypt | Eastern Desert | Sinai Peninsula | NAA | Lead isotopes | Early Bronze Age Anatolia

## Klima

### KUITEMS 2019

M. Kuitems, T. van Kolfschoten, A. N. Tikhonov & J. van der Plicht, *Woolly mammoth  $\delta^{13}C$  and  $\delta^{15}N$  values remained amazingly stable throughout the last  $\approx 50,000$  years in north-eastern Siberia*. [Quaternary International](#) (2019), preprint, 1–8. DOI:10.1016/j.quaint.2019.03.001.

QuatInt2019.03-Kuitems-Supplement1.pdf, QuatInt2019.03-Kuitems-Supplement2.pdf

The range of the woolly mammoth (*Mammuthus primigenius*) covered the northern circumpolar region, over time varying in size and space due to changes in regional climatic conditions. The species survived multiple glacial cycles, but got extinct around the end of the last glacial, between  $\approx 21,000$  and 4000 years ago. Stable carbon ( $d13C$ ) and nitrogen ( $d15N$ ) data of woolly mammoth fossils from western Eurasia and Alaska, show considerable variation during periods of global climatic change and towards time of regional extinction. In North-eastern Siberia, the woolly mammoth survived several millennia longer. The fossil record from Northeastern Siberia yields, therefore, crucial ecological information about the living conditions of the woolly mammoth and plays an important role in the debate about the cause of its extinction. The current dataset comprises an unprecedented amount of  $d13C$  and  $d15N$  data of directly radiocarbon-dated woolly mammoth skeletal samples from North-eastern Siberia, including numerous Holocene samples from Wrangel Island. This study shows that the  $d13C$  and  $d15N$  values of the woolly mammoth remained amazingly stable in this region throughout the last  $\approx 50,000$  years of its existence.



## LANGGUT 2015

Dafna Langgut, Israel Finkelstein, Thomas Litt, Frank Harald Neumann & Mordechai Stein, *Vegetation and Climate Changes During the Bronze and Iron Ages ( $\approx 3600$ – $600$  BCE) in the Southern Levant Based on Palynological Records*. [Radiocarbon 57 \(2015\), 217–235](#).

This article presents the role of climate fluctuations in shaping southern Levantine human history from 3600 to 600 BCE (the Bronze and Iron Ages) as evidenced in palynological studies. This time interval is critical in the history of the region; it includes two phases of rise and decline of urban life, organization of the first territorial kingdoms, and domination of the area by great Ancient Near Eastern empires. The study is based on a comparison of several fossil pollen records that span a north-south transect of 220 km along the southern Levant: Birkat Ram in the northern Golan Heights, Sea of Galilee, and Ein Feshkha and Ze'elim Gully both on the western shore of the Dead Sea. The vegetation history and its climatic implications are as follows: during the Early Bronze Age I ( $\approx 3600$ – $3000$  BCE) climate conditions were wet; a minor reduction in humidity was documented during the Early Bronze Age II–III ( $\approx 3000$ – $2500$  BCE). The Intermediate Bronze Age ( $\approx 2500$ – $1950$  BCE) was characterized by moderate climate conditions, however, since  $\approx 2000$  BCE and during the Middle Bronze Age I ( $\approx 1950$ – $1750$  BCE) drier climate conditions were prevalent, while the Middle Bronze Age II–III ( $\approx 1750$ – $1550$  BCE) was comparably wet. Humid conditions continued in the early phases of the Late Bronze Age, while towards the end of the period and down to  $\approx 1100$  BCE the area features the driest climate conditions in the timespan reported here; this observation is based on the dramatic decrease in arboreal vegetation. During the period of  $\approx 1100$ – $750$  BCE, which covers most of the Iron Age I ( $\approx 1150$ – $950$  BCE) and the Iron Age IIA ( $\approx 950$ – $780$  BCE), an increase in Mediterranean trees was documented, representing wetter climate conditions, which followed the severe dry phase of the end of the Late Bronze Age. The decrease in arboreal percentages, which characterize the Iron Age IIB ( $\approx 780$ – $680$  BCE) and Iron Age IIC ( $\approx 680$ – $586$  BCE), could have been caused by anthropogenic activity and/or might have derived from slightly drier climate conditions. Variations in the distribution of cultivated olive trees along the different periods resulted from human preference and/or changes in the available moisture.

## O'HARE 2019

Paschal O'Hare et al., *Multiradionuclide evidence for an extreme solar proton event around 2,610 B.P. ( $\approx 660$  BC)*. [PNAS 116 \(2019\), 5961–5966](#).

[pnas116-05961-Supplement1.pdf](#), [pnas116-05961-Supplement2.xlsx](#)

Paschal O'Hare, Florian Mekhaldi, Florian Adolphi, Grant Raisbeck, Ala Aldahan, Emma Anderberg, Jurg Beer, Marcus Christl, Simon Fahrni, Hans-Arno Synal, Junghun Park, Goran Possnert, John Southon, Edouard Bard, A. S. T. E. R. Team & Raimund Muscheler

Recently, it has been confirmed that extreme solar proton events can lead to significantly increased atmospheric production rates of cosmogenic radionuclides. Evidence of such events is recorded in annually resolved natural archives, such as tree rings [carbon-14 ( $^{14}\text{C}$ )] and ice cores [beryllium-10 ( $^{10}\text{Be}$ ), chlorine-36 ( $^{36}\text{Cl}$ )]. Here, we show evidence for an extreme solar event around 2,610 years B.P. ( $\approx 660$  BC) based on high-resolution  $^{10}\text{Be}$  data from two Greenland ice cores. Our conclusions are supported by modeled  $^{14}\text{C}$  production rates for the same period. Using existing  $^{36}\text{Cl}$  ice core data in conjunction with  $^{10}\text{Be}$ , we further show that this solar event was characterized by a very hard energy spectrum. These results indicate that the 2,610-years B.P. event was an order of magnitude stronger than any

solar event recorded during the instrumental period and comparable with the solar proton event of AD 774/775, the largest solar event known to date. The results illustrate the importance of multiple ice core radionuclide measurements for the reliable identification of short-term production rate increases and the assessment of their origins.

**Keywords:** solar storms | radionuclides | ice cores | solar proton events

**Significance:** This study provides evidence of an enormous solar storm around 2,610 B.P. It is only the third such event reliably documented and is comparable with the strongest event detected at AD 774/775. The event of 2,610 years B.P. stands out because of its particular signature in the radionuclide data [i.e., carbon-14 ( $^{14}\text{C}$ ) data alone does not allow for an unequivocal detection of the event]. It illustrates that present efforts to find such events based solely on  $^{14}\text{C}$  data likely lead to an underestimated number of such potentially devastating events for our society. In addition to  $^{14}\text{C}$  data, high-resolution records of beryllium-10 and chlorine-36 are crucial for reliable estimates of the occurrence rate and the properties of past solar proton events.

## SEWELL 2019

L. Sewell, G. Merceron, P. J. Hopley, B. Zipfel & S. C. Reynolds, *Using springbok (*Antidorcas*) dietary proxies to reconstruct inferred palaeovegetational changes over 2 million years in Southern Africa*. [Journal of Archaeological Science: Reports](#) **23** (2019), 1014–1028.

The reconstruction of past vegetation and climatic conditions of the Cradle of Humankind, Gauteng Province, South Africa, has been approached using various proxies (such as micromammals, speleothems, faunal and floral presence and stable carbon isotopes). Elisabeth Vrba's seminal studies (1974; 1975) on the fossil record of this region indicated dramatic faunal turnover based on species extinction and speciation data. This turnover was thought to have been driven by increasing aridity and spreading grasslands. These reconstructions however, are continuously being refined and adapted in light of advancing techniques (such as dental microwear textural analysis) and terrestrial proxies, such as speleothems. However, more recent studies show varying proportions from wooded towards more grassland-dominated habitats, with the most common reconstruction being the heterogeneous 'mosaic' habitat. Here we re-evaluate the findings of a transition from woodland to grassland conditions in the fossil record from Member 4 Sterkfontein to Member 5 Sterkfontein and the deposits of Swartkrans. To approach the palaeovegetation changes through time via a different angle, we focus on the diet of the springbok (genus *Antidorcas*), represented throughout this temporal period from geological members dating from 2.8–0.8 Ma. We use detailed dietary Methods (dental linear measurements, mesowear, microwear, and stable carbon isotope analysis) to explore past changes in diets of springbok that can be used to indicate the prevailing vegetation conditions. Our results presented here broadly agree with previous palaeoenvironmental reconstructions, in indicating increased grassland post ca 1.7 Ma, with some suggestion of more heterogeneous habitats for Swartkrans Member 2 (ca 1.65–1.07 Ma). We find that there is support for the implementation of a multi-disciplinary approach to produce more accurate and robust reconstructions of past diets and by extension, of palaeovegetation conditions, if the selected herbivore species is a mixed-feeder, like the springbok.

**Keywords:** Microwear | Mesowear | Springbok | Isotopes | Cradle of Humankind | Plio-Pleistocene | Sterkfontein | Swartkrans | Dietary paleoecology

## SHUMAN 2019

Bryan N. Shuman, Jeremiah Marsicek, W. Wyatt Oswald & David R.

Foster, *Predictable hydrological and ecological responses to Holocene North Atlantic variability*. *PNAS* **116** (2019), 5985–5990.

pnas116-05985-Supplement.pdf

Climate variations in the North Atlantic region can substantially impact surrounding continents. Notably, the Younger Dryas chronozone was named for the ecosystem effects of abrupt changes in the region at circa (ca.) 12.9–11.7 ka (millennia before 1950 AD). Holocene variations since then, however, have been hard to diagnose, and the responsiveness of terrestrial ecosystems continues to be debated. Here, we show that Holocene climate variations had spatial patterns consistent with changes in Atlantic overturning and repeatedly steepened the temperature gradient between Nova Scotia and Greenland since >8 ka. The multicentury changes correlated with hydrologic and vegetation changes in the northeast United States, including when an enhanced temperature gradient coincided with subregional droughts indicated by waterlevel changes at multiple coastal lakes at 4.9–4.6, 4.2–3.9, 2.8–2.1, and 1.3–1.2 ka. We assessed the variability and its effects by replicating signals across sites, using converging evidence from multiple Methods, and applying forward models of the systems involved. We evaluated forest responses in the northeast United States and found that they tracked the regional climate shifts including the smallest magnitude ( $\approx 5\%$  or 50 mm) changes in effective precipitation. Although a long-term increase in effective precipitation of >45% (>400 mm) could have prevented ecological communities from equilibrating to the continuously changing conditions, our comparisons confirm stable vegetation–climate relationships and support the use of fossil pollen records for quantitative paleoclimate reconstruction. Overall, the network of records indicates that centennial climate variability has repeatedly affected the North Atlantic region with predictable consequences.

**Keywords:** drought | vegetation | North Atlantic | Holocene | climate

**Significance:** The importance of climate change arises from effects on natural resources like water and ecosystems. Diagnosing the predictability of these effects in the past can help to anticipate future changes, while also clarifying the paleoclimate record. We examined >8,000 y of climate variations and their effects in the North Atlantic region, where ocean and atmosphere processes have often produced global consequences and altered climates from one century to the next. We found that repeated temperature variations across the region followed patterns consistent with climate dynamics that affected water and forests in North America. Forest plant communities changed rapidly and predictably, which underscores both the risk of future change and the potential to reconstruct paleoclimates using fossil evidence.

## SZPAK 2010

Paul Szpak et al., *Regional differences in bone collagen  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  of Pleistocene mammoths, Implications for paleoecology of the mammoth steppe*. *Palaeo* **286** (2010), 88–96.

Paul Szpak, Darren R. Grocke, Regis Debruyne, Ross D. E. MacPhee, R. Dale Guthrie, Duane Froese, Grant D. Zazula, William P. Patterson & Hendrik N. Poinar

In this study, we present bone collagen  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values from a large set of Pleistocene woolly mammoths (*Mammuthus primigenius*) from Siberia, Alaska and Yukon. Overall, results for mammoth specimens from eastern Beringia (Alaska and Yukon) significantly differ, for both  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values, from those from western Beringia (northeastern Siberia). In agreement with palynological, entomological, and physiographic data from the same regions, these isotopic differences strongly imply that the ‘mammoth steppe,’ the extensive ice-free region spanning northern

Eurasia and northwestern North America, was ecologically variable along its east-west axis to a significant degree. Prior to the Last Glacial Maximum (LGM), the high-latitude portions of Siberia and the Russian Far East appear to have been colder and more arid than central Alaska and Yukon, which were ecologically more diverse. During the LGM itself, however, isotopic signatures of mammoths from eastern Beringia support the argument that this region also experienced an extremely cold and arid climate. In terms of overall temporal trend, Beringia thus went from a condition prior to the LGM of greater ecological variability in the east to one of uniformly cold and dry conditions during the LGM.

Keywords: Stable isotopes | Bone collagen | Woolly mammoth | Paleoecology | Beringia | Mammoth steppe

## Kultur

ELLENS 2019

J. Harold Ellens, *The Ancient Library of Alexandria, The West's most important repository of learning*. [Bible History Daily 2019, Mar. 12, 1–8](#).

That is the story of the Alexandria Library, too. After destroying the library, the Arabs preserved a large percentage of the ancient volumes—as evidenced by the fact that they possessed, in Greek and Arabic translations, many of the works of the ancient poets, playwrights, scientists and philosophers, including Plato, Aristotle, Euclid and Eratosthenes. When the European Crusaders encountered the Arabic world in the 11th and 12th centuries, those venerable works became known again in Europe, giving rise to the Renaissance. Islamic philosophers and scientists—such as Averroës, a Spanish Arab (1126–1198 C.E.), and Avicenna, a Persian (980–1037 C.E.)—gave the ancient books and their wisdom back to the Western world and taught Christian Europe to know again and prize its roots in ancient Greece.

So the ancient library of Alexandria rose like a phoenix from her own ashes. She has been wounded, perhaps, but has never really died.

## Metallzeiten

ESHEL 2019

Tzilla Eshel, Yigal Erel, Naama Yahalom-Mack, Ofir Tirosh & Ayelet Gilboa, *Lead isotopes in silver reveal earliest Phoenician quest for metals in the west Mediterranean*. [PNAS 116 \(2019\), 6007–6012](#).

[pnas116-06007-Supplement.pdf](#)

When and why did the Phoenicians initiate long-term connections between the Levant and western Europe? This is one of the most hotly debated questions in ancient Mediterranean history and cultural research. In this study, we use silver to answer this question, presenting the largest dataset of chemical and isotopic analyses of silver items from silver hoards found in Phoenician homeland sites. Intertwining lead isotope analysis of silver items with precise archaeological context and chronology, we provide analytical evidence for the onset of Phoenician westward expansion. We suggest that the quest for silver instigated a long, exploratory phase, first in Anatolia (Asia Minor) and Sardinia, and subsequently in the Iberian Peninsula. This phase preceded the establishment of sustainable, flourishing Phoenician colonies in the West by over a century. In so doing, our results buttress the “precolonization” theory, accord it a firm chronological framework,

and demonstrate that the quest for silver (and probably other metals) was an incentive for Phoenician westward expansion. Furthermore, our results show that the Phoenicians introduced innovative silver production methods to historic Europe.

**Keywords:** silver | lead isotope analysis | Phoenicians | Sardinia | Iberia

**Significance:** We offer here an answer to one of the most intriguing questions in ancient Mediterranean history: the timing/contexts and incentives of early Phoenician expansion to Mediterranean and Atlantic regions in Africa and Europe  $\approx$ 3,000 years ago. This was enabled by a rare opportunity to analyze a very large sample set of ancient silver items from Phoenicia. An interdisciplinary collaboration combining scientific methods with precise archaeological data revealed the Phoenicians' silver sources. We propose that Phoenicians brought silver to the Levant from southwest Sardinia  $\approx$ 200 years before they de facto settled there, and later, gradually, also from Iberia. We show that the quest for silver was a major trigger for a long "precolonization" phase, during the 10th to 9th centuries BCE.

## Methoden

### BEN-YOSEF 2018

Erez Ben-Yosef, *Provenancing Egyptian metals, A methodological comment*. [Journal of Archaeological Science](#) **96** (2018), 208–215.

Two recent studies (Kmošek et al., 2018; Rademakers et al., 2018) provide the first comprehensive lead isotope dataset for copper-based artifacts from Protodynastic to Old Kingdom Egypt. These studies constitute important steps forward in our understanding of early Egyptian metallurgy and raw materials procurement strategies. In tandem, it is suggested that these and future studies can benefit from a modular presentation of interpretational insights that takes into account differences in the insights' robustness and susceptibility to change as more data become available. More generally, it is argued that the success of provenance and other archaeometallurgical studies is dependent on proper treatment of the ever-growing analytical data, which requires communal efforts in establishing and maintaining shared databases. Regarding the interpretation of the new analytical data on early Egypt, caution is advised when relying on archaeological evidence of Egyptian activity in mining regions (Eastern Desert and Sinai), as this might obscure other sources, and hinder the discovery of "invisible connections" (cf., Kmošek et al., 2018) – one of the greatest advantages of analytical approach.

**Keywords:** Lead isotope analysis | Copper | Ancient Egypt | Old Kingdom | Provenance studies | Mining archaeology | Archaeometallurgy

### FINKELSTEIN 2015

Israel Finkelstein, Steve Weiner & Elisabetta Boaretto, *Preface—The Iron Age in Israel, The Exact and Life Sciences Perspectives*. [Radiocarbon](#) **57** (2015), 197–206.

### McFADDEN 2019

Clare McFadden & Marc F. Oxenham, *The impacts of underenumeration and age estimation error on the D0–14/D ratio and palaeodemographic measures*. [Journal of Archaeological Science: Reports](#) **23** (2019), 57–61.

The objectives of this study were to evaluate the impacts of infant and elderly underenumeration and age estimation error on previously reported measures derived from the D0–14/D ratio, specifically total fertility rate and the rate of

natural increase. This study used data from the United Nations database for the year 1960. A twostep approach was taken: to test the stability of the relationship we examined the correlation between the D0–14/D ratio and population dynamics of interest with data omitted or misclassified to simulate a range of sample underrepresentation and age estimation error scenarios. To evaluate the practical implications, we used our existing equations to estimate total fertility and natural increase rates using the simulated differentially represented samples and calculated the standard error of the estimate. Correlations remained robust until a small number of infants and the elderly were represented. Where both infants and the elderly were underrepresented, as much as 75 % of these age categories could be removed before accuracy of the equations was significantly compromised. Where either infant underenumeration or elderly underenumeration is suspected, our palaeodemographic measures maintain accuracy when up to 25 % of the sample is missing. Age estimation error had a negligible impact. These measures demonstrated robusticity in a range of sample underenumeration scenarios, particularly for sources of bias that impact both infants and the elderly equally, and age estimation error. Where either infants or the elderly have been significantly underrepresented or omitted from the burial site, alternative measures may be required.

**Keywords:** Palaeodemography | Fertility rate | Rate of natural increase | Infant underenumeration | Elderly underenumeration

## Neolithikum

LÜNING 2009

Jens Lüning, *Bandkeramische Hofplätze und Erbregeln*. In: TOBIAS L. KIENLIN & ANDREAS ZIMMERMANN (Hrsg.), *Beyond Elites – Alternatives to Hierarchical Systems in Modelling Social Formations, International Conference at the Ruhr-Universität Bochum, Germany October 22–24, 2009; Teil 1*. Universitätsforschungen zur prähistorischen Archäologie 215 ([Bonn 2012](#)), 197–201.

Der “Besitz” an Feld und Wald wurde mit den Häusern vererbt, und zwar als Ganzes “vom Vater auf den Sohn”. Erben konnte, wenn mehrere Söhne vorhanden waren, nur einer, denn da die bandkeramischen Großhäuser in den 500 Jahren der bandkeramischen Kultur trotz der beschriebenen Schwankungen im Prinzip die gleiche Größe behielten, muss auch die zugehörige Landwirtschaft prinzipiell gleich groß geblieben sein.<sup>9</sup> Eine Aufteilung des Besitzes auf mehrere Söhne, also eine Zersplitterung, fand nicht statt; es herrschte vielmehr, modern gesprochen, das “Anerbenrecht” und nicht die “Realteilung”. Welcher Sohn erbte, ist unklar. Die nicht erbberechtigten Brüder konnten im Rahmen der “Erweiterten Familie” als minderberechtigte Mitglieder auf dem heimischen Hof verbleiben, solange dessen Tragfähigkeit ausreichte. Andernfalls mussten sie oder spätestens ihre Nachkommenschaft “auswandern”. Wie die archäologische Geschichte der Siedlungsverbände zeigt (Abb. 2), reichte für viele eine “Binnenkolonisation” in der unmittelbaren Nachbarschaft.

## Story or Book

BIETAK 2019

Manfred Bietak, *The Enigma of the Hyksos*. [unknown \(2019\), preprint, 1–14](#).



According to this reviewer, who in some matters may have different ideas, this is altogether the best and most up-to-date book written thus far about the Hyksos. Although it is composed mainly from an archaeological perspective, it also incorporates the pertinent textual material. This book is even more remarkable as the author has not had the opportunity to study the site and antiquities of Avaris by autopsy. The resulting volume is the product of years of intensive studies and analyses, and has hardly omitted a single relevant source or monument. The author should be congratulated for this great achievement.

Mourad, A.-L. – Rise of the Hyksos. Egypt and the Levant from the Middle Kingdom to the Early Second Intermediate Period. (Archaeopress Egyptology, 11). Archaeopress, Oxford, 2016. (29,5 cm, XIV, 310, 4 Plates). ISBN 978-1-78491-133-1; ISBN 978 1 78491 134 8 (e-Pdf). £ 48.00)

Originating from a thesis at the Macquarie University in Sydney, Anna-Latifa Mourad presents the most thorough survey of sites of the hybrid Middle Bronze Age Culture in Egypt and reviews pertinent places in the Levant alike in order to assess the phenomenon of the domination of Egypt by Western Asiatic rulers, known as the Hyksos. On top of it she also reviews all relevant inscriptions, stelae and tomb representations of Asiatic people living in Egypt during the time of the Middle Kingdom. She assembles from all this scattered evidence a picture of the foreigners who dominated Egypt in the 17th and 16th century BC. According to her analysis these settlers came from the northern Levant and contributed substantially to the culture and policy of the New Kingdom. It is one of the best books on the Hyksos ever written. The research of the author will have an impact on the above described project on the Enigmatic Dynasty of the Hyksos.

#### DAWSON 2019

Robert Dawson, *The Librarian*. [nature 567 \(2019\), 564](#).

Methods of preservation.

Should it rearrange the books to eliminate the dark gaps like missing teeth, where books had gone missing? It had been seven years since there had been a budget for acquisition or replacement.

#### KILLICK 1995

David Killick, *Early Metal Mining and Production*. [Geoarchaeology \(1995\), 169–171](#).

Early Metal Mining and Production. Paul T. Craddock, 1995, Smithsonian Institution Press, xix 1 363 pp., \$59.00 (hardbound).

I can unhesitatingly recommend this book as the most accurate and authoritative text available on preindustrial mining and metallurgy, but it is not flawless. Inevitably, given Craddock's commendable attempt to be comprehensive, he has missed some material that would be known to regional specialists. For example, his skepticism about the feasibility of iron smelting by natural draft in Africa (p. 177) is unfounded. The book is also much stronger on the nonferrous metals than on iron and steel, the coverage of which is uneven. There is excellent treatment of the bloomery process and of crucible steel production, but the crucial transition to water-powered bellows and trip-hammers is barely mentioned. Even more perplexing is the scant attention given to the early blast furnace and associated technologies, such as the fining of cast to wrought iron. From the standpoint of economic and social history, these technologies were of far greater significance than esoteric technologies such as crucible steel making and decorative techniques such as pattern welding, both of which are well covered in this book. There is in fact almost no treatment in this book of economic and social aspects of mining and metallurgy.



## LAMB 2019

Evelyn Lamb, *The joy of stats.* [nature 567 \(2019\), 458–459.](#)

Evelyn Lamb enjoys a rich study on number-crunching and its ubiquitous fruit.

*The Art of Statistics: Learning from Data.* David Spiegelhalter. Pelican (2019)

Statistics software can now perform a battery of tests and crunch any measure from large data sets in the blink of an eye. Thus, being able to compute the standard deviation of a sample the long way is seen as less essential than understanding how to design and interpret scientific studies with a rigorous eye.

Spiegelhalter does not shy away from discussions of subtle statistical issues such as the nature of different types of uncertainty. So, as he warns at the beginning of chapter 9, where the rubber of mathematical probability theory hits the road of statistical inference, some material will prove challenging even to scientifically sophisticated readers. Some passages require pencil, paper and a few passes through to fully digest, but the approachable big-picture explanations and end-of-chapter summaries help, as does the glossary. A useful coda focuses on the many dubious statistical practices that have helped to create today's replication crisis across swathes of science.