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Literatur

Afrika

Stojanowski 2011

Christopher M. Stojanowski & Charisse L. Carver, *Inference of emergent cattle pastoralism in the southern Sahara desert based on localized hypoplasia of the primary canine*. International Journal of Paleopathology **1** (2011), 89–97.

There are limited data on the health effects of the transition to food production in North Africa where Middle Holocene peoples adopted pastoralism to mitigate a deteriorating climate. Unlike other areas of domestication the advent of food production throughout the Sahara, and much of Africa, was decoupled from increasing sedentism and population aggregation. Here, we consider the effects of this dietary transition on early childhood health by examining localized hypoplasia of the primary canine (LHPC). We focus on the Gobero region of Niger which preserves cemeteries containing skeletal remains from two occupation phases: (1) an Early Holocene/Kiffian fisher-forager phase, and (2) a Middle Holocene/Tenerian cattle pastoralism phase. The fisher-foragers exhibited one of the highest recorded frequencies of LHPC which we interpret as reflecting a diet of aquatic and terrestrial taxa of low fat content. The Middle Holocene population had a significantly lower frequency of LHPC, consistent with cattle providing much needed dietary fat. Because cattle remains were uncommon at Gobero, the most parsimonious interpretation suggests these peoples were incipient cattle pastoralists who had yet to develop into ideological pastoralists. The health benefits of cattle pastoralism demonstrate the importance of pastoral products for peoples coping with a deteriorating desert climate.

Keywords: Enamel hypoplasia | North Africa | Pastoralism

Aktuell

Bettencourt 2011

Luís M. A. Bettencourt & Jasleen Kaur, *Evolution and structure of sustainability science*. PNAS **108** (2011), 19540–19545.

The concepts of sustainable development have experienced extraordinary success since their advent in the 1980s. They are now an integral part of the agenda of governments and corporations, and their goals have become central to the mission of research laboratories and universities worldwide. However, it remains unclear how far the field has progressed as a scientific discipline, especially given its ambitious agenda of integrating theory, applied science, and policy, making it relevant for development globally and generating a new interdisciplinary synthesis across fields. To address these questions, we assembled a corpus of scholarly publications in the field and analyzed its temporal evolution, geographic distribution, disciplinary composition, and collaboration structure. We show that sustainability science has been growing explosively since the late 1980s when foundational publications in the field increased its pull on new authors and intensified their interactions. The field has an unusual geographic footprint combining contributions and connecting through collaboration cities and nations at very different levels of development. Its decomposition into traditional disciplines reveals its emphasis on the management of human, social, and ecological systems seen primarily from an engineering and policy perspective. Finally, we show that the integration of these perspectives has

created a new field only in recent years as judged by the emergence of a giant component of scientific collaboration. These developments demonstrate the existence of a growing scientific field of sustainability science as an unusual, inclusive and ubiquitous scientific practice and bode well for its continued impact and longevity.
science of science | population dynamics | geography | topological transition | networks

KATES 2011

Robert W. Kates, *What kind of a science is sustainability science?* PNAS **108** (2011), 19449–19450.

I conclude with my initial question as to what kind of a science is sustainability science. Both the insider and outsider stories answer that sustainability science is a different kind of science that is primarily use-inspired, as are agricultural and health sciences, with significant fundamental and applied knowledge components, and commitment to moving such knowledge into societal action. In just over 2 decades, it has attracted tens of thousands of research authors, practitioners, and knowledge users, as well as teachers and students, with a geographical, institutional, and disciplinary footprint very different from most science. However, its real test of success will be in implementing its knowledge to meet the great environment and development challenges of this century.

Anthropologie

CASPI 2007

Avshalom Caspi et al., *Moderation of breastfeeding effects on the IQ by genetic variation in fatty acid metabolism.* PNAS **104** (2007), 18860–18865.

pnas104-18860-Supplement.htm

Avshalom Caspi, Benjamin Williams, Julia Kim-Cohen, Ian W. Craig, Barry J. Milne, Richie Poulton, Leonard C. Schalkwyk, Alan Taylor, Helen Werts and Terrie E. Moffitt
Children's intellectual development is influenced by both genetic inheritance and environmental experiences. Breastfeeding is one of the earliest such postnatal experiences. Breastfed children attain higher IQ scores than children not fed breast milk, presumably because of the fatty acids uniquely available in breast milk. Here we show that the association between breastfeeding and IQ is moderated by a genetic variant in FADS2, a gene involved in the genetic control of fatty acid pathways. We confirmed this gene-environment interaction in two birth cohorts, and we ruled out alternative explanations of the finding involving gene-exposure correlation, intrauterine growth, social class, and maternal cognitive ability, as well as maternal genotype effects on breastfeeding and breast milk. The finding shows that environmental exposures can be used to uncover novel candidate genes in complex phenotypes. It also shows that genes may work via the environment to shape the IQ, helping to close the nature versus nurture debate.
cognitive development | gene environment interaction

VON CRAMON-TAUBADEL 2011

Noreen von Cramon-Taubadel, *Global human mandibular variation reflects differences in agricultural and hunter-gatherer subsistence strategies.* PNAS **108** (2011), 19546–19551.

Variation in the masticatory behavior of hunter-gatherer and agricultural populations is hypothesized to be one of the major forces affecting the form of the human mandible. However, this has yet to be analyzed at a global level. Here, the relationship between global mandibular shape variation and subsistence economy is tested, while controlling for the potentially confounding effects of shared population history, geography, and climate. The results demonstrate that the mandible, in contrast to the cranium, significantly reflects subsistence strategy rather than neutral genetic patterns, with hunter-gatherers

having consistently longer and narrower mandibles than agriculturalists. These results support notions that a decrease in masticatory stress among agriculturalists causes the mandible to grow and develop differently. This developmental argument also explains why there is often a mismatch between the size of the lower face and the dentition, which, in turn, leads to increased prevalence of dental crowding and malocclusions in modern postindustrial populations. Therefore, these results have important implications for our understanding of human masticatory adaptation.
diet | phenotypic plasticity | mastication | skull

Enattah 2008

Nabil Sabri Enattah et al., *Independent Introduction of Two Lactase-Persistence Alleles into Human Populations Reflects Different History of Adaptation to Milk Culture.* American Journal of Human Genetics **82** (2008), 57–72.

AmJHumGen82-0057-Supplement.pdf
Nabil Sabri Enattah, Tine G.K. Jensen, Mette Nielsen, Rikke Lewinski, Mikko Kuokkanen, Heli Rasinpera, Hatem El-Shanti, Jeong Kee Seo, Michael Alifrangis, Insaf F. Khalil, Abdrazak Natah, Ahmed Ali, Sirajedin Natah, David Comas, S. Qasim Mehdi, Leif Groop, Else Marie Vestergaard, Faiqa Imtiaz, Mohamed S. Rashed, Brian Meyer, Jesper Troelsen and Leena Peltonen
The T-13910 variant located in the enhancer element of the lactase (LCT) gene correlates perfectly with lactase persistence (LP) in Eurasian populations whereas the variant is almost nonexistent among Sub-Saharan African populations, showing high prevalence of LP. Here, we report identification of two new mutations among Saudis, also known for the high prevalence of LP.We confirmed the absence of the European T-13910 and established two new mutations found as a compound allele: T/G-13915 within the -13910 enhancer region and a synonymous SNP in the exon 17 of the MCM6 gene T/C-3712, -3712 bp from the LCT gene. The compound allele is driven to a high prevalence among Middle East population(s). Our functional analyses in vitro showed that both SNPs of the compound allele, located 10 kb apart, are required for the enhancer effect, most probably mediated through the binding of the hepatic nuclear factor 1 a (HNF1a). High selection coefficient (s) ≈0.04 for LP phenotype was found for both T-13910 and the compound allele. The European T-13910 and the earlier identified East African G-13907 LP allele share the same ancestral background and most likely the same history, probably related to the same cattle domestication event. In contrast, the compound Arab allele shows a different, highly divergent ancestral haplotype, suggesting that these two major global LP alleles have arisen independently, the latter perhaps in response to camel milk consumption. These results support the convergent evolution of the LP in diverse populations, most probably reflecting different histories of adaptation to milk culture.

Hollox 2001

Edward J. Hollox et al., *Lactase Haplotype Diversity in the Old World.* American Journal of Human Genetics **68** (2001), 160–172.

Edward J. Hollox, Mark Poulter, Marek Zvarik, Vladimir Ferak, Amanda Krause, Trefor Jenkins, Nilmani Saha, Andrew I. Kozlov and Dallas M. Swallow
Lactase persistence, the genetic trait in which intestinal lactase activity persists at childhood levels into adulthood, varies in frequency in different human populations, being most frequent in northern Europeans and certain African and Arabian nomadic tribes, who have a history of drinking fresh milk. Selection is likely to have played an important role in establishing these different frequencies since the development of agricultural pastoralism ≈9,000 years ago. We have previously shown that the element responsible for the lactase persistence/nonpersistence polymorphism in humans is cis-acting to the

lactase gene and that lactase persistence is associated, in Europeans, with the most common 70-kb lactase haplotype, A.We report here a study of the 11-site haplotype in 1,338 chromosomes from 11 populations that differ in lactase persistence frequency. Our data show that haplotype diversity was generated both by point mutations and recombinations. The four globally common haplotypes (A, B, C, and U) are not closely related and have different distributions; the A haplotype is at high frequencies only in northern Europeans, where lactase persistence is common; and the U haplotype is virtually absent from Indo-European populations. Much more diversity is seen in sub-Saharan Africans than in non-Africans, consistent with an "Out of Africa" model for peopling of the Old World. Analysis of recent recombinant haplotypes by allele-specific PCR, along with deduction of the root haplotype from chimpanzee sequence, allowed construction of a haplotype network that assisted in evaluation of the relative roles of drift and selection in establishing the haplotype frequencies in the different populations. We suggest that genetic drift was important in shaping the general pattern of non-African haplotype diversity, with recent directional selection in northern Europeans for the haplotype associated with lactase persistence.

Kaiser 2004

Jocelyn Kaiser, *Ural Farmers Got Milk Gene First?* science **306** (2004), 1284–1285.

The populations having the greatest DNA sequence diversity around the lactase gene mutations-suggesting that lactose tolerance first appeared in them-include the Udmurts, Mokshas, Ezras, and other groups that originally lived between the Ural mountains and the Volga River. The trait most likely developed 4800 to 6600 years ago, Peltonen says. Her team linked the lactase gene changes to an ancestral variant that these groups apparently got from intermixing with tribes migrating from the Asian steppes.
The findings support the somewhat controversial theory that nomadic herders known as Kurgans expanded into Europe from the southern Urals 4500 to 3500 years ago, bringing Indo-European languages with them, according to Peltonen.

Rose 2011

Jeffrey I. Rose et al., *The Nubian Complex of Dhofar, Oman: An African Middle Stone Age Industry in Southern Arabia*. PLoS ONE **6** (2011), e28239. DOI:10.1371/journal.pone.0028239.

Jeffrey I. Rose, Vitaly I. Usik, Anthony E. Marks, Yamandu H. Hilbert, Christopher S. Galletti, Ash Parton, Jean Marie Geiling, Viktor Černˆ2, Mike W. Morley & Richard G. Roberts
Despite the numerous studies proposing early human population expansions from Africa into Arabia during the Late Pleistocene, no archaeological sites have yet been discovered in Arabia that resemble a specific African industry, which would indicate demographic exchange across the Red Sea. Here we report the discovery of a buried site and more than 100 new surface scatters in the Dhofar region of Oman belonging to a regionally-specific African lithic industry – the late Nubian Complex – known previously only from the northeast and Horn of Africa during Marine Isotope Stage 5, ,128,000 to 74,000 years ago. Two optically stimulated luminescence age estimates from the open-air site of Aybut Al Auwal in Oman place the Arabian Nubian Complex at ,106,000 years ago, providing archaeological evidence for the presence of a distinct northeast African Middle Stone Age technocomplex in southern Arabia sometime in the first half of Marine Isotope Stage 5.

Biologie

Molkentin 2007

Joachim Molkentin & Anette Giesemann, *Differentiation of organically*

and conventionally produced milk by stable isotope and fatty acid analysis. Analytical and Bioanalytical Chemistry **388** (2007), 297–305.

Increasing sales of organic milk mean intensified tests for authenticity are required. In addition to comprehensive documentation, analytical methods to identify organic milk, and thus to differentiate it from conventional milk, are needed for consumer protection. Because the composition of milk is fundamentally dependent on the feeding of the cows, thirty-five samples from both production systems in Germany, including farm and retail milk, were collected within 12 months, to reflect seasonal variation, and appropriate properties were analysed. Fatty acid analysis enabled organic and conventional milk to be completely distinguished, because of the higher á-linolenic acid (C18:3ω3) and eicosapentaenoic acid (C20:5ω3) content of the former. Organic milk fat contained at least 0.56 % C18:3ω3 whereas the maximum in conventional milk was 0.53 %. Because of the parallel seasonal course of the C18:3ω3 content of organic and conventional retail samples, however, time-resolved comparison at the five sampling dates resulted in a clearer difference of 0.34±0.06 % on average. Analysis of stable carbon isotopes (d13C) also enabled complete distinction of both types of milk; this can be explained by the different amounts of maize in the feed. For conventional milk fat d13C values were -26.6‰ or higher whereas for organic milk fat values were always lower, with a maximum of -28.0‰. The time-resolved average difference was 4.5±1.0‰. A strong negative correlation (r=.0.92) was found between C18:3ω3 and d13C. Analysis of a larger number of samples is required to check the preliminary variation ranges obtained in this pilot study and, probably, to adjust the limits. Stable isotopes of nitrogen (d15N) or sulfur (d34S) did not enable assignment of the origin of the milk; in cases of ambiguity, however, some trends observed might be useful in combination with other properties.

Keywords Stable isotopes | Fatty acids | Differentiation | Identification | Organic milk production | Conventional milk production

Murray 2009

T. L. Murray, D. B. Blache & R. Bencini, *The selection of dairy sheep on calm temperament before milking and its effect on management and milk production.* Small Ruminant Research **87** (2009), 45–49.

We studied the milk production, milk composition and behaviour in the dairy of ewes classified as calm through temperament testing. We hypothesised that calm sheep would not be stressed by milking, and would therefore have complete milk ejections and increased milk yields compared to nervous sheep. The temperaments of 95 experienced dairy ewes were measured in a social challenge 3 weeks before parturition, and their behaviour was observed and milk was sampled during machine milking from approximately 2 to 10 weeks after lambing. Based on their temperament scores, two distinct groups of calm ewes (n = 16) and nervous ewes (n = 16) were generated. There was no difference between calm and nervous ewes in their frequency of kicks and unloading scores. During the first week of recording, calm ewes were less reluctant to enter the milking parlour and, from approximately week 3 onwards, it took less time to attach the milking cups to calm ewes. There was an interaction between time and temperament on milk production, which provides evidence that the evolution of milk yield differs between temperaments, with calm ewes producing an average of 462±36 g/day while nervous ewes averaged 394±33 g/day. However, there was no effect of temperament or time on the concentration of fat or protein in the milk. Our results suggest that selection for temperament may play a role in moderating milk production by ewes and also contribute to their behaviour on the platform.

Keywords: Sheep | Dairy | Temperament | Behaviour | Milk production

Datierung

Hyodo 2011

Masayuki Hyodo et al., *High-resolution record of the Matuyama-Brunhes transition constrains the age of Javanese Homo erectus in the Sangiran dome, Indonesia.* PNAS **108** (2011), 19563–19568.

Masayuki Hyodo, Shuji Matsu'ura, Yuko Kamishima, Megumi Kondo, Yoshihiro Takeshita, Ikuko Kitaba, Tohru Danhara, Fachroel Aziz, Iwan Kurniawan and Hisao Kumai
A detailed paleomagnetic study conducted in the Sangiran area, Java, has provided a reliable age constraint on hominid fossilbearing formations. A reverse-to-normal polarity transition marks a 7-m thick section across the Upper Tuff in the Bapang Formation. The transition has three short reversal episodes and is overlain by a thick normal polarity magnetozone that was fission-track dated to the Brunhes chron. This pattern closely resembles another highresolution Matuyama-Brunhes (MB) transition record in an Osaka Bay marine core. In the Sangiran sediments, four successive transitional polarity fields lie just below the presumed main MB boundary. Their virtual geomagnetic poles cluster in the western South Pacific, partly overlapping the transitional virtual geomagnetic poles from Hawaiian and Canary Islands' lavas, which have a mean 40Ar/39Ar age of 776 ± 2 ka. Thus, the polarity transition is unambiguously the MB boundary. A revised correlation of tuff layers in the Bapang Formation reveals that the hominid last occurrence and the tektite level in the Sangiran area are nearly coincident, just below the Upper Middle Tuff, which underlies the MB transition. The stratigraphic relationship of the tektite level to the MB transition in the Sangiran area is consistent with deep-sea core data that show that the meteorite impact preceded the MB reversal by about 12 ka. The MB boundary currently defines the uppermost horizon yielding Homo erectus fossils in the Sangiran area.

paleomagnetism | marine isotope stage 19 | magnetostratigraphy | geochronology

Energie

Calabrese 2011

Edward Calabrese, *Improving the scientific foundations for estimating health risks from the Fukushima incident.* PNAS **108** (2011), 19447–19448.

Numerous expert advisory groups / governmental agencies have rendered guidance based on hypothetical risks of Cs-137. This guidance often converges, providing comparable risk estimates. Estimates of human risk are typically highly precise, giving the false impression of considerable accuracy. Such similarity of estimation often results from copycat thinking and little independent analysis. However, the public can become confused when informed that acceptable levels of Cs-137 in Japan are more than threefold that permitted in the Ukraine. Even more confusing is when the European Union raised acceptable levels of Cs-137 in food by 20-fold in response to Fukushima. Getting reliable information, as well as trying to understand the basis of such governmental actions, can be difficult. Also very frustrating are the questionable scientific foundations on which these various guidance decisions are based.

Although the precautionary philosophy can have value, it is not without its downside. The presence of multiple highly conservative assumptions can lead to a cascading of multiplicative protective factors that can add substantial increases in remediation costs without validated assurances of accompanying benefit. When the precautionary principle is taken too far, it may adversely affect human health if it reduces exposures below those at which beneficial adaptive responses are induced. The "lower is always better" mantra of regulatory agencies will often counter the goal of enhancing public health.

Since Chernobyl, governments and the nuclear industry have failed to address these and other critical research questions, all of which plague the current crisis of Fukushima. It has long been known that a fission nuclear plant accident release would include major concerns with Cs-137. It is time for the responsible governmental and industrial organizations to develop a practical plan to fill important data gaps. It is also critical that the LNT model and alternative models, such as the threshold and hormesis models, be objectively assessed so that society can be guided by scientific data and validated models rather than ideological perspectives that stealthily infected the risk assessment process for ionizing radiation and carcinogenic chemicals.

Kinoshita 2011

Norikazu Kinoshita et al., *Assessment of individual radionuclide distributions from the Fukushima nuclear accident covering central-east Japan*. PNAS **108** (2011), 19526–19529.

Norikazu Kinoshita, Keisuke Sueki, Kimikazu Sasa, Jun-ichi Kitagawa, Satoshi Ikarashi, Tomohiro Nishimura, Ying-Shee Wong, Yukihiko Satou, Koji Handa, Tsutomu Takahashi, Masanori Sato and Takeyasu Yamagata

A tremendous amount of radioactivity was discharged because of the damage to cooling systems of nuclear reactors in the Fukushima No. 1 nuclear power plant in March 2011. Fukushima and its adjacent prefectures were contaminated with fission products from the accident. Here, we show a geographical distribution of radioactive iodine, tellurium, and cesium in the surface soils of central-east Japan as determined by gamma-ray spectrometry. Especially in Fukushima prefecture, contaminated area spreads around Iitate and Naka-Dori for all the radionuclides we measured. Distributions of the radionuclides were affected by the physical state of each nuclide as well as geographical features. Considering meteorological conditions, it is concluded that the radioactive material transported on March 15 was the major contributor to contamination in Fukushima prefecture, whereas the radioactive material transported on March 21 was the major source in Ibaraki, Tochigi, Saitama, and Chiba prefectures and in Tokyo.

gamma-ray spectrometry | individual radioactivity | deposition

Yasunari 2011

Teppei J. Yasunari, Andreas Stohl, Ryugo S. Hayano, John F. Burkhart, Sabine Eckhardt & Tetsuzo Yasunari, *Cesium-137 deposition and contamination of Japanese soils due to the Fukushima nuclear accident*. PNAS **108** (2011), 19530–19534.

pnas108-19530-Supplement1.mov, pnas108-19530-Supplement2.mov, pnas108-19530-Supplement3.mov, pnas108-19530-Supplement4.mov

The largest concern on the cesium-137 (137Cs) deposition and its soil contamination due to the emission from the Fukushima Daiichi Nuclear Power Plant (NPP) showed up after a massive quake on March 11, 2011. Cesium-137 (137Cs) with a half-life of 30.1 y causes the largest concerns because of its deleterious effect on agriculture and stock farming, and, thus, human life for decades. Removal of 137Cs contaminated soils or land use limitations in areas where removal is not possible is, therefore, an urgent issue. A challenge lies in the fact that estimates of 137Cs emissions from the Fukushima NPP are extremely uncertain, therefore, the distribution of 137Cs in the environment is poorly constrained. Here, we estimate total 137Cs deposition by integrating daily observations of 137Cs deposition in each prefecture in Japan with relative deposition distribution patterns from a Lagrangian particle dispersion model, FLEXPART. We show that 137Cs strongly contaminated the soils in large areas of eastern and northeastern Japan, whereas western Japan was sheltered by mountain ranges. The soils around Fukushima NPP and neighboring prefectures have been extensively contaminated with depositions of

more than 100,000 and 10,000 MBq km2, respectively. Total 137Cs depositions over two domains: (i) the Japan Islands and the surrounding ocean (130–150 °E and 30–46 °N) and, (ii) the Japan Islands, were estimated to be more than 5.6 and 1.0 PBq, respectively. We hope our 137Cs deposition maps will help to coordinate decontamination efforts and plan regulatory measures in Japan.
aerosol | dispersion modeling | radioactive fallout

Isotope

Balasse 2002

Marie Balasse & Anne Tresset, *Early Weaning of Neolithic Domestic Cattle (Bercy, France) Revealed by Intra-tooth Variation in Nitrogen Isotope Ratios*. Journal of Archaeological Science **29** (2002), 853–859.
Evaluating the role of milk production in prehistoric subsistence economies requires a better estimation of the capacity of a milk-oriented husbandry under prehistoric conditions. Weaning pattern, which is linked to the length of lactation, is an important parameter in this estimation. In this study, weaning pattern is closely examined in Neolithic cattle from the site of Bercy (Paris, France, c. 4000 BC), by a study of intra-tooth (M1, M2) variation in the nitrogen isotope ratios (d15N) of dentine collagen. Collagen 15N is commonly used to trace the change of trophic level at weaning time. The pattern of change in collagen 15N in the first molar of two archaeological bovines is then compared with that observed in modern cattle weaned at known age. Results suggest that the Neolithic calves were weaned early. This could reflect either a shorter lactation for Neolithic cows, or early weaning imposed by the herder in order to reserve a bigger proportion of milk production for human consumption.
Keywords: Milk Production, Weaning, Neolithic, Nitrogen Isotope Ratios, Collagen, Dentine.

Chu 2006

Nan-Chin Chu, Gideon M. Henderson, Nick S. Belshaw & Robert E. M. Hedges, *Establishing the potential of Ca isotopes as proxy for consumption of dairy products*. Applied Geochemistry **21** (2006), 1656–1667.
AppGeochem21-1656-Supplement.pdf
A procedure has been developed which allows precise determination of Ca isotope ratios in natural and organic samples such as bones, milk and other biological materials. In this study the procedure is used to determine Ca isotope ratios in modern dietary systems and to establish the potential of Ca isotopes as a paleodiet tracer by analysis of bones. Multi-sampling across a 5 cm portion of a red deer jawbone shows invariant Ca isotope ratios and suggests negligible isotopic effect during bone remodelling. The difference between Ca isotopes in red deer diet and bones from one location was 0.65‰, in agreement with a previous study of diet/bone offsets. Similar values for modern deer-bone d44/42Ca from four geographically diverse populations demonstrate that geological/environmental conditions do not cause large variability and suggest that diet is the major cause for variations in bone d44/42Ca. d44/42Ca of herbivore milk is found to be ≈0.5 to 0.6 higher than the corresponding diet. Modern human milk has a d44/42Ca of -1.15 (n = 4) and is isotopically the lightest material reported in this study. This suggests that, for these samples, a significant portion of Ca intake was from dairy sources, and that human milk has Ca which is, again, ≈0.6‰ isotopically lighter than dietary Ca intake. Finally, Ca isotope ratios are presented from a variety of samples formed during fermentation processes (e.g., curds, whey, etc.) which indicate that these processes do not fractionate Ca isotopes significantly. Together, the data in this paper indicate that, because milk is an important

dietary source of Ca with a distinctive signature, Ca isotope ratios should provide a tracer for past dairy consumption. A simplified model is outlined to demonstrate the ability to quantify dairy consumption by the analysis of Ca isotopes in bones.

Gregg 2009

M. W. Gregg, E. B. Banning, K. Gibbs & G. F. Slater, *Subsistence practices and pottery use in Neolithic Jordan: molecular and isotopic evidence*. Journal of Archaeological Science **36** (2009), 937–946.

This paper presents direct evidence of subsistence practices and pottery use at a Late Neolithic site at al-Basatîn, northern Jordan. Measurable concentrations of C16:0 and C18:0 were recovered from 8 of 10 archaeological pottery fragments through use of a microwave-assisted silica gel and aminopropyl solvent protocol developed for the isolation and concentration of free fatty acids in marine sediments. Subsequent isotopic analysis of the surviving C16:0 and C18:0 saturated fatty acids revealed d13C ratios consistent with those of adipose fats of ruminant and non-ruminant animals pastured on lands adjacent to the Jordan Valley. The high recovery of diagnostic compounds from the al-Basatîn material is discussed in context of a wider examination of the initial development and use of pottery in the Fertile Crescent, and the emerging debate concerning the efficacy of stable carbon isotope values in characterizing organic residues embedded in pottery fragments recovered from the earliest ceramic horizons in the Middle East and Europe.
Keywords: al-Basatîn | Jordan | Wadi Ziqlab | Neolithic | Archaeological pottery | Organic residues | GC-MS, GCdC-IRMS | d13C values | Microwave-assisted extraction

Reynard 2008

L. M. Reynard & R. E. M. Hedges, *Stable hydrogen isotopes of bone collagen in palaeodietary and palaeoenvironmental reconstruction*. Journal of Archaeological Science **35** (2008), 1934–1942.

JArchSci35-1934-Supplement.pdf

The stable hydrogen isotope ratios (dD) of bone collagen in archaeological human and animal samples demonstrate a trophic level effect, with increasing dD from herbivores to omnivores to humans, in steps of 10-30‰. In addition the archaeological sites studied (Yarnton, Eton Rowing Lake, Danebury Environs – Suddern Farm, and Windmill Hill in the UK, Balatonszárszó in Hungary, and Huari in Peru) demonstrate geographical variation in dD. The detection of manuring in prehistory by comparison of d15N to dD values in humans and a local herbivore (cattle) is also considered. This work is the first to measure dD in a large number and range of archaeological samples, with several animal species and humans. It demonstrates unequivocally that dD is different between species in ancient material, increasing from herbivores to omnivores to carnivores.
Keywords: Hydrogen; Stable isotopes; Trophic level; Palaeoclimate; Palaeodiet; Bone; Collagen

Reynard 2010

L. M. Reynard, G. M. Henderson & R. E. M. Hedges, *Calcium isotope ratios in animal and human bone*. Geochimica et Cosmochimica Acta **74** (2010), 3735–3750.

GeoCosmo74-3735-Supplement.pdf

Calcium isotopes in tissues are thought to be influenced by an individual's diet, reflecting parameters such as trophic level and dairy consumption, but this has not been carefully assessed. We report the calcium isotope ratios (d44/42Ca) of modern and archaeological animal and human bone (n = 216). Modern sheep raised at the same location show 0.14 ± 0.08‰ higher d44/42Ca in females than in males, which we attribute to lactation by the ewes. In the archaeological bone samples the calcium isotope ratios of the herbivorous

fauna vary by location. At a single site, the archaeological fauna do not show a trophic level effect. Humans have lower d44/42Ca than the mean site fauna by 0.22 ± 0.22‰, and the humans have a greater d44/42Ca range than the animals. No effect of sex or age on the calcium isotope ratios was found, and intra-individual skeletal d44/42Ca variability is negligible. We rule out dairy consumption as the main cause of the lower human d44/42Ca, based on results from sites pre-dating animal domestication and dairy availability, and suggest instead that individual physiology and calcium intake may be important in determining bone calcium isotope ratios.

Towers 2011

Jacqueline Towers, Mandy Jay, Ingrid Mainland, Olaf Nehlich & Janet Montgomery, *A calf for all seasons? The potential of stable isotope analysis to investigate prehistoric husbandry practices*. Journal of Archaeological Science **38** (2011), 1858–1868.

The Early Bronze Age barrows at Irthlingborough and Gayhurst in central England are notable for the large number of cattle (Bos taurus) remains associated with their human Beaker burials. Previous work using strontium isotope analysis has indicated that most of the cattle analysed, and one aurochs (Bos primigenius), were of local origin. In this study, stable isotope analysis of enamel and bone was carried out to investigate whether the mature cattle had experienced similar husbandry practices, climate and environment. Bulk carbon, nitrogen and sulphur isotope analysis of collagen suggested most were consuming similar sources of plant protein from environments probably local to the sites and this was supported by high resolution intra-enamel carbon isotope profiles. Oxygen isotope profiles indicated the aurochs and most of the cattle experienced similar climatic regimes: the only exception being an animal with a non-local strontium isotope ratio. However, a comparison of seasonality profiles of the local animals using estimated tooth formation times showed that there was no consistency in season of birth: the animals appeared to have been born throughout the year. Cattle can breed throughout the year but it requires considerable human effort and intervention to successfully overwinter young stock; it is therefore unlikely to have been carried out without good reason and benefit if winters were harsh. One reason is to ensure a continuous supply of milk. Measuring oxygen isotope profiles to identify year-round calving may thus be a potential indicator of dairying economies.

Keywords: Stable isotope analysis | Tooth enamel | Bone collagen | Intra-tooth sampling | Cattle husbandry | Dairying

Travis 2008

John Travis, *Trail of Mare's Milk Leads to First Tamed Horses*. science **322** (2008), 368.

Stear reported at the meeting that she found the isotopic signature of mare's milk on 5500-year-old pottery fragments from Kazakhstan. "It is the smoking gun for horse domestication, since no one would attempt to milk a wild mare." Stear used carbon isotopes to confirm the presence of equine fats on about 50 Botai shards, but the method couldn't distinguish between lipids from milk or meat. So she tested local horse meat and koumiss and confirmed a hypothesis posed by Evershed and Alan Outram of the University of Exeter, U.K.: that horse meat and milk contain different amounts of the hydrogen isotope deuterium. For reasons related to the isotope's heavier weight, summer rains in the region contain much more deuterium than winter precipitation. Because mares are only milked after they foal in the spring, researchers theorized that the isotope would be concentrated in milk, whereas horse meat's deuterium signal would be averaged over the course of each year. Testing the ancient potsherds, Stear found that five had the horsemilk deuterium signature. "The way she did it was quite elegant," says Oliver Craig, a biomolecular archaeologist at the University of York.

Kultur

Copley 2005a

M. S. Copley, R. Berstan, S. N. Dudd, V. Straker, S. Payne & R. P. Evershed, *Dairying in antiquity. I. Evidence from absorbed lipid residues dating to the British Iron Age*. Journal of Archaeological Science **32** (2005), 485–503.

The evidence for dairying in antiquity has, until recently, primarily been restricted to the reconstruction of herd structures through the analysis of faunal remains. Using this method alone cannot provide definitive evidence for the presence of dairy herds, due to differences in the recovery of animal bones at sites and the many different farming strategies that can affect herd structures (e.g. dairying, meat production, traction etc.). Absorbed lipid residues have been extracted from 237 pottery vessels from the British Iron Age sites of Maiden Castle, Danebury Hillfort, Yarnton Cresswell Field and Stanwick. The compound-specific stable carbon isotope (d13C values) of the principal fatty acids found in animal fats (C16:0 and C18:0) have allowed the direct detection of dairy fats, thus providing evidence that dairying was an important component of farming practices in the British Iron Age. The results are compared to assessments of the faunal remains at each of the sites, and correlations between morphological characteristics of the vessels (e.g. type, form, use wear and rim diameter) and lipid residue discussed.

Keywords: Organic residues; Lipids; Stable carbon isotopes; d13C values; Iron Age; Pottery vessels; Diet; Agriculture; Dairying

Copley 2005b

M. S. Copley, R. Berstan, V. Straker, S. Payne & R. P. Eversheda, *Dairying in antiquity. II. Evidence from absorbed lipid residues dating to the British Bronze Age*. Journal of Archaeological Science **32** (2005), 505–521.

Molecular and isotopic analyses were undertaken of absorbed lipid residues from 256 pottery vessels obtained from four southern British Bronze Age sites (Potterne, Brean Down, Black Patch and Trethellan Farm). The results confirm that not only were ancient Britons utilising dairy products during this period, but also that they were processed in pottery vessels on a large scale. This has been demonstrated through the determination of the compound-specific stable carbon isotope values of the principal fatty acids found in animal fats (C16:0 and C18:0) that allows ruminant dairy and ruminant/non-ruminant adipose fats to be distinguished. The proportion of sherds yielding degraded dairy fats at each of the sites is variable, with the highest occurrence being from Potterne, and the lowest occurrence being from Black Patch. The faunal remains, and vessel characteristics (e.g. rim diameter and vessel type) are compared with the organic residue analyses, and intra-site variability is investigated at Trethellan Farm.

Keywords: Organic residues; Lipids; Fatty acids; Stable carbon isotopes; d13C values; Diet; Bronze Age; Pottery vessels; Agriculture; Dairying

Copley 2005c

M. S. Copley, R. Berstan, A. J. Mukherjee, S. N. Dudd, V. Straker, S. Payne & R. P. Evershed, *Dairying in antiquity. III. Evidence from absorbed lipid residues dating to the British Neolithic*. Journal of Archaeological Science **32** (2005), 523–546.

Absorbed lipid residue analysis has previously demonstrated that dairying was a major component of animal husbandry in Britain during both the Iron Age and Bronze Age. As a continuation of this research into the antiquity of dairying, the incidence of dairy fats associated with pottery vessels from six Neolithic sites from Southern Britain is presented herein. A total of 438 potsherds from Windmill Hill, Abingdon Causewayed Enclosure, Hambledon Hill, Eton Rowing Lake, Runnymede Bridge and Yarnton Floodplain were

submitted for organic residue analysis. To date, this constitutes the largest number of sherds investigated from one particular archaeological period. The compound-specific stable carbon isotope values of the major fatty acid components in animal fats, namely C16:0 and C18:0, enable absorbed lipids in pottery vessels to be classified to commodity group, i.e. ruminant adipose, dairy and non-ruminant adipose fats can be distinguished. The lipid extracts were relatively well preserved, and dairy fats were observed in approximately 25 % of all of the sherds, demonstrating that milk was a valued commodity in the British Neolithic. These results confirm that dairying was an established component of the agricultural practices that reached Britain in the 5th Millennium BC.
Keywords: Organic residues; Lipids; Stable carbon isotopes; d13C values; Neolithic; Pottery vessels; Diet; Agriculture; Dairying

Fall 2002

Patricia L. Fall, Steven E. Falconer & Lee Lines, *Agricultural Intensification and the Secondary Products Revolution Along the Jordan Rift*. Human Ecology **30** (2002), 445–482.

The ecological impacts of early agriculture in the Near East remained localized prior to the intensified production of derivative plant and animalproducts, beginning in the fourth millennium B.C. One aspect of this "secondary products revolution" (Sherratt, 1980a, 1983) involved the adoption of animal traction and increased production of rendered animal commodities (e.g., wool and dairy). However, most of the pervasive regional effects of this revolution followed from the domestication and increasingly intensive cultivation of orchard crops that generated marketable secondary products (e.g., olive oil, wine, and dried fruits) and encouraged widespread deforestation. In the southern Levant this revolution encouraged, and was encouraged by, the rise and fall of Bronze Age towns and their mercantile influences. Botanical and palynological data from the Jordan Rift reveal a complex discontinuous legacy of changes wrought by the secondary products revolution that have molded the agrarian ecology and anthropogenic landscapes characteristic of the region today.
KEY WORDS: agricultural intensification; anthropogenic forests; Middle East; secondary products; urbanism.

Hubbard 2010

Emily M. Hubbard, *Livestock and people in a Middle Chalcolithic settlement: a micromorphological investigation from Tel Tsaf, Israel*. Antiquity **84** (2010), 1123–1134.

Round and rectangular buildings with grain silos at a Copper Age site in Israel suggested social stratification to the excavators. Using micromorphology, the author demonstrates that while the rectangular building was occupied by people, the round ones had contained animals, perhaps as providers of milk, and dung for fuel. While this removes the direct indication of social variance, it strengthens the argument that animals, as well as grain, formed the basis for the creation of surplus.
Keywords: Levant, Chalcolithic, animal pens, micromorphology, social structure, surplus

Koepke 2008

Nikola Koepke & Joerg Baten, *Agricultural specialization and height in ancient and medieval Europe*. Explorations in Economic History **45** (2008), 127–146.

Land per capita was one important determinant of height in the Malthusian world 0 to 1800 A.D. A second factor was specialization in milk cattle agriculture. It had two positive effects on human stature: first, proximity to protein production resulted in a very low local shadow price of milk, as this important foodstuff could not be transported

easily. Second, this low price resulted in a low inequality of nutritional status, whereas, for example, tradable pork contributed to nutritional inequality. For this study, we used a data set of more than two million animal bones to measure specialization in cattle and its impact on stature.
Keywords: Anthropometrics; Agriculture; Cattle farming; Very long run; Growth; Living standards; Taphonomy; Archaeozoology

Wu 2011

Xiu-Jie Wu, Lynne A. Schepartz, Wu Liu, & Erik Trinkaus, *Antemortem trauma and survival in the late Middle Pleistocene human cranium from Maba, South China*. PNAS **108** (2011), 19558–19562.
Paleopathological assessment of the late Middle Pleistocene archaic human cranium from Maba, South China, has documented a right frontal squamous exocranially concave and ridged lesion with endocranial protrusion. Differential diagnosis indicates that it resulted from localized blunt force trauma, due to an accident or, more probably, interhuman aggression. As such it joins a small sample of pre-last glacial maximum Pleistocene human remains with probable evidence of humanly induced trauma. Its remodeled condition also indicates survival of a serious pathological condition, a circumstance that is increasingly documented for archaic and modern Homo through the Pleistocene.
injury | fracture | skull | Asia

Methoden

Craig 2000

Oliver Craig, Jacqui Mulville, Mike Parker Pearson, Robert Sokol, Keith Gelsthorpe, Rebecca Stacey & Matthew Collins, *Detecting milk proteins in ancient pots*. nature **408** (2000), 312.
Compared with meat production, dairying is a high-input, high-output, high-risk operation indicative of an intensive, sophisticated economy, but this practice is notoriously difficult to demonstrate in the archaeological record. Here we provide evidence for the presence of milk proteins preserved in prehistoric vessels, which to our knowledge have not been detected before.

Craig 2005

O. E. Craig, G. Taylor, J. Mulville, M. J. Collins & M. Parker Pearson, *The identification of prehistoric dairying activities in the Western Isles of Scotland: an integrated biomolecular approach*. Journal of Archaeological Science **32** (2005), 91–103.
The antiquity of dairying in regions considered to be marginal, such as the Western Isles of Scotland, has generated considerable debate. Complementary biomolecular methods are now available for identifying milk residues on ceramic vessels, which provides direct evidence for this practice in the past. A range of late Bronze Age and Iron Age ceramic cooking vessels were selected from two sites on South Uist, an island in the Outer Hebrides. The presence of milk proteins and lipids on a high proportion of potsherds confirms that these vessels were originally used to process dairy products. These data were integrated with evidence from the faunal remains and ethnographic accounts, in order to examine the wider significance and implications of dairy production in the Western Isles of Scotland during the first millennium BC. Further evidence from the pottery typologies and their depositional contexts were considered in order to comment on preparation and consumption practices.
Keywords: Dairying; Scotland; Prehistory; Proteins; Lipids; Food residues; Milk

Kirsanow 2011

Karola Kirsanow & Joachim Burger, *Ancient human DNA*. Annals of Anatomy (2011) preprint, 1–25. DOI:10.1016/j.aanat.2011.11.002.
The contribution of palaeogenetic data to the study of various aspects of hominin biology and evolution has been significant, and has the potential to increase substantially with the widespread implementation of Next Generation Sequencing techniques. Here we discuss the present state-of-the-art of ancient human DNA analysis and the characteristics of hominin aDNA that make sequence validation particularly complex. A brief overview of the development of anthropological palaeogenetic analysis is given to illustrate the technical challenges motivating recent technological advancements.

Stoneking 2006

Mark Stoneking, *Investigating the health of our ancestors: Insights from the evolutionary genetic consequences of prehistoric diseases*. International Congress Series **1296** (2006), 106–114.
Investigations into the health and diseases of prehistoric human populations are traditionally based on various approaches for analyzing skeletal remains. In this paper, I propose that a complementary approach, based on patterns of genetic variation in contemporary populations, can also provide insights into prehistoric health and disease. The idea is that selection for increased reproductive fitness, because of some selective force (such as resistance to a particular disease), will leave a signature on the gene(s) involved. I describe how modern genomic approaches can identify such genes, and two examples are given of genes that have clearly been influenced by selection. However, while modern genomics is making it relatively straightforward to identify genes that have been subject to selection, the challenge still remains as to how to identify the responsible selective force.
Keywords: Genome scan; Selection; Genetic distance; Lactase persistence; Prion protein

Neolithikum

Arbuckle 2009

Benjamin S. Arbuckle & Cheryl A. Makarewicz, *The early management of cattle (Bos taurus) in Neolithic central Anatolia*. Antiquity **83** (2009), 669–686.
The authors use metrical, demographic and body part analyses of animal bone assemblages in Anatolia to demonstrate how cattle were incorporated into early Neolithic subsistence economies. Sheep and goats were domesticated in the eighth millennium BC, while aurochs, wild cattle, were long hunted. The earliest domesticated cattle are not noted until the mid-seventh millennium BC, and derive from imported stock domesticated elsewhere. In Anatolia, meanwhile, the aurochs remains large and wild and retains its charisma as a hunted quarry and a stud animal.
Keywords: Anatolia, Neolithic, faunal analysis, aurochs, cattle, LSI, survivorship, skeletal parts distribution

Gallagher 2009

A. Gallagher, M. M. Gunther & H. Bruchhaus, *Population continuity, demic diffusion and Neolithic origins in central-southern Germany: The evidence from body proportions*. HOMO—Journal of Comparative Human Biology **60** (2009), 95–126.
The transition to agro-pastoralism in central Europe has been framed within a dichotomy of "regional continuity" versus exogenous "demic diffusion". While substantial genetic

support exists for a model of demographic diffusion from an ancestral source in the Near East, archaeological data furnish weak support for the "wave of advance" model. Nevertheless, archaeological evidence attests the widespread introduction of an exogenous "package" comprising ceramics, cereals, pulses and domesticated animals to central Europe at 5600 cal BCE.
Body proportions are under strong climatic selection and evince remarkable stability within regional lineages. As such, they offer a viable and robust alternative to craniofacial data in assessing hypothesised continuity and replacement with the transition to agro-pastoralism in central Europe. Humero-clavicular, brachial and crural indices in a large sample (n = 75) of Linienbandkeramik (LBK), Late Neolithic and Early Bronze Age specimens from the middle Elbe-Saale-Werra valley (MESV) were compared with Eurasian and African terminal Pleistocene, European Mesolithic and geographically disparate recent human specimens.
Mesolithic Europeans display considerable variation in humero-clavicular and brachial indices yet none approach the extreme "hyper-polar" morphology of LBK humans from the MESV. In contrast, Late Neolithic and Early Bronze Age peoples display elongated brachial and crural indices reminiscent of terminal Pleistocene and "tropically adapted" recent humans. These marked morphological changes likely reflect exogenous immigration during the terminal Fourth millennium cal BC. Population expansion and diffusion is a function of increased mobility and settlement dispersal concomitant with significant technological and subsistence changes in later Neolithic societies during the late fourth millennium cal BCE.

Sherratt 1983

Andrew Sherratt, *The Secondary Exploitation of Animals in the Old World*. World Archaeology **15** (1983), 90–104.
This paper considers the range of evidence for the secondary uses and products of animals: traction, transport, wool and milk. It suggests that early farming populations used livestock mainly for meat, and that other applications were explored as agriculturalists adapted to new conditions, especially in the semi-arid zone. Innovations in different parts of the Near East were exchanged and disseminated as part of the process leading to urbanisation. Their dispersal affected both the steppe belt, which saw a marked increase in population, and also temperate Europe, where agriculture was revolutionised by more extensive methods of farming and landscape clearance.

Tresset 2011

Anne Tresset & Jean-Denis Vigne, *Last hunter-gatherers and first farmers of Europe*, *Les derniers chasseurs-cueilleurs et les premiers agriculteurs en Europe*. Comptes Rendus Biologies **334** (2011), 182–189.
The Neolithisation of Europe has seen the transformation of hunting-gathering societies into farming communities. At least partly exogenous in its origins, this process led to major transformations in many aspects of life-styles, such as social structures, land use or diet. It involved the arrival of new human populations and gave way to the importation, intentional or unwanted of many non-European animal and plant species. It also provoked important changes in interactions between humans and natural environments. In many respects, it set the foundations of long-term European peasantry developments and prefigured later agropastoral colonizations. As such, it must be seen as a major turning point in the history of European populations.
Keywords: Neolithic | Europe | Domesticates | Cultigens | Farming techniques | Diet change | Population adaptations