in the context of historical, paleobiological, and modern records of the long-term natural and anthropogenic influences on marine ecosystems, archaeology is a powerful tool for helping better understand contemporary environmental problems.

Today, coastal archaeological sites around the world are increasingly threatened by accelerated sea level rise and erosion, development and construction projects, looting, and many other processes. As research into human impacts on ancient marine ecosystems continues to grow, we also need to work to conserve the fragile and disappearing global coastal archaeological record that is the foundation for this research.

Cross-References

▶ Environmental Archaeology and Conservation
▶ Historical Ecology and Environmental Archaeology
▶ Ichthyoarchaeology
▶ Pacific Ocean: Maritime Archaeology

References

Caldwell, M. E., D. Lepofsky, G. Combes, M. Washington, J. R. Welch & J. R. Harper. 2012. A bird's eye view of Coast Salish intertidal resource management features, southern British Columbia, Canada. *Journal of Island and Coastal Archaeology* 7: 219-33.

Crumley, C. L. (ed.) 1994. *Historical ecology: cultural knowledge and changing landscapes*. Santa Fe (NM): School of American Research.

Kirch, P. V. & T. L. Hunt. (ed.) 1997. *Historical ecology in the Pacific Islands: prehistoric environmental and landscape change*. New Haven: Yale University Press.

Further Reading

Braje, T. 2010. *Modern oceans, ancient sites: archaeology and marine conservation on San Miguel Island, California*. Salt Lake City: University of Utah Press.

Erlandson, J. & S. Fitzpatrick. 2006. Oceans, islands, and coasts: current perspectives on the role of the sea in human prehistory. *Journal of Island and Coastal Archaeology* 1: 5-32.

Erlandson, J. & T. Rick. 2010. Archaeology meets marine ecology: the antiquity of maritime cultures and human impacts on marine fisheries and ecosystems. *Annual Review of Marine Science* 2: 231-51.

Jackson, J., K. Alexander & E. Salia. (ed) 2011. *Shifting baselines: the past and future of ocean fisheries*. New York: Island Press.

Kirch, P. 2005. Archaeology and global change: the Holocene record. *Annual Review of Environmental Resources* 30: 409-40.

Reitz, E. 2004. "Fishing down the food web": a case study from St. Augustine, Florida, USA. *American Antiquity* 69: 63-83.

Rick, T. & J. Erlandson. 2009. Coastal exploitation. *Science* 325: 953-4.

Rick, T. & J. Erlandson. (ed.) 2008. *Human impacts on ancient marine ecosystems: a global perspective*. Berkeley: University of California Press.

Human Migration: Bioarchaeological Approaches

David C. Meiggs[1] and Carolyn Freiwald[2]
[1]Laboratory for Archaeological Chemistry, Department of Anthropology, University of Wisconsin-Madison, Madison, WI, USA
[2]Department of Sociology and Anthropology, University of Mississippi, Oxford, MS, USA

Introduction

Migration is one of the key characteristics of humanity, and population movements are as varied as human culture itself. Identifying migration in the past represents one of the most critical questions that archaeologists address because it affects nearly every aspect of life, like the availability of sufficient land, food, and marriage partners. Archaeologists traditionally use material objects to recognize ancient societies, which makes identification of population movement a difficult endeavor. When does a change in material culture represent an influx of new people into a region, and when does it reflect new trade goods or ideas? Some of the most critical changes in human history, such as the transition from hunting and gathering to farming, hinge on the answer to this question. Advances in biogeochemical research methods like isotopic and DNA analyses have resulted in significant advances toward resolving some of these longstanding dilemmas.

When applied within an integrated research strategy, bioarchaeological approaches to human mobility provide a unique set of data that illuminate facets of the past not otherwise obtainable by the archaeologist. For example, a contextual analysis of seasonal and geographic mobility of livestock excavated from a large, urban center provides information on a society's economy, social organization, and use of its environment. The precise "origin" of the animals matters less than how patterns might differ between house compounds, quarters of the city, and market areas. In this entry, we attempt to capture the diversity of questions archaeologists ask about ancient mobility using bioarchaeological approaches.

Definition

A bioarchaeological approach does not imply a specific analytical technique, but a suite of anthropological research questions. The term "bioarchaeology" may refer to the analysis of anything biological recovered from an archaeological site, or only of *human* skeletal material. North American use of the term denotes an integrated, multidisciplinary research strategy that focuses on archaeological human remains to reconstruct life histories and population structure (Buikstra & Beck 2006). However, human skeletal remains do not represent the full range of materials that archaeologists use globally to investigate migration in past societies. Analyses may also include population genetics of modern humans and archaeological fauna as proxies for human mobility.

What is migration, and how do archaeologists attempt to identify it? Archaeologists have traditionally focused on one-way, long-distance movements where a group colonizes an uninhabited area or displaces an existing population (e.g., Rouse 1986). However, human mobility is far more complex, and this limited perspective excludes most types of population movement throughout history (Anthony 1990). Individuals or groups may change residence seasonally to herd livestock. Or an individual may relocate more than once, either within a political entity or across a regional or national boundary. Relocation may also be involuntary, as in the case of the slave trade. Migration includes each of these types of movement, as neither the distance nor the reason for the move form critical parts of the definition.

Historical Background

Diffusionism provided the initial framework that archaeologists used to explain cultural evolution. During the late nineteenth and early twentieth centuries, scholars generally made a direct connection between changes in artifact styles and ethnically distinct groups, using migration to explain social change. At the same time, studies of human skeletal variability relied on racial typologies, with migration and admixture figuring prominently in the influential work of Hrdlička and Hooton (Armelagos & van Gerven 2003).

During the 1960s, the theoretical and methodological shift of processual archaeology seriously challenged the role of migration (and invasion) as an explanation for past sociocultural change and decoupled a simplistic linkage between artifacts and people. The emergence of a biocultural approach in analysis of human skeletal remains reflected these trends, and incorporated population movement and relatedness. However, processual archaeology marginalized migration as an explanatory framework, and it only reemerged during the 1980s (see detailed discussion in Trigger 2006).

Currently, research focuses not only on reconstructing patterns of population movement, but also on how mobility articulates with aspects of social organization and identity (e.g., contributions to Knudson & Stojanowski 2009). Archaeological analyses used to reconstruct human mobility fall into three general categories: osteological, biogeochemical, and genetic (Table 1). None of these techniques provide simple "answers" about mobility or

Human Migration: Bioarchaeological Approaches, Table 1 Bioarchaeological techniques used to reconstruct ancient mobility

Category	Techniques	Evidence for mobility
Osteological	• Biodistance Cranial/ postcranial (including dental) metric and nonmetric variation	• Genetic relatedness – kinship and mate choice • Regional variation in cranial or dental modification/ decoration
Biogeochemical	• "Light" isotopes: carbon ($\delta^{13}C$), nitrogen ($\delta^{15}N$), oxygen ($\delta^{18}O$), and sulfur ($\delta^{34}S$) • "Heavy" isotopes: strontium ($^{87}Sr/^{86}Sr$) and lead (Pb) • Trace elemental ratios: Sr/Ca and Ba/Ca	• Regional differences in diet • Differences in diet and water isotopic composition show geographic mobility
Genetic	• mtDNA • Nuclear DNA • aDNA • Polymorphisms in other biomolecules other than DNA Blood factors: ABO, Rh, HLA, etc.	• Population history/phylogeny • Emergence of new alleles (e.g., lactase persistence)

relationships between past peoples. Each method incorporates certain assumptions that may result in more than one possible explanation for the same data, which limits the types of questions archaeologists can ask. Archaeologists cannot address mobility in the same ways that modern anthropologists, demographers, and geographers can. Therefore, multiple lines of evidence are fundamental to understanding past human mobility.

Osteological approaches are characterized by macroscopic examination of archaeological human remains and form an essential core of approaches to past mobility through biological and genetic distance analysis. So-called biodistance studies are based on measurement of cranial or dental metric or nonmetric traits. Mobility is inferred from deviations from regionally defined averages and has been used to consider gender-specific postmarital residence patterns, as well as regional gene flow and interaction (Buikstra & Beck 2006). Although current research emphasizes population genetic-based perspectives, there is some concern that typological (i.e., essentially "racial") approaches persist (Armelagos & van Gerven 2003).

Biogeochemical approaches to mobility take advantage of differences in isotopic signatures in human tissues that reflect systematic environmental variability. Trace element ratios, specifically strontium and barium, also are used to evaluate mobility (Burton et al. 2003). Early analysis of isotopes in archaeological material focused on paleoclimate and dietary reconstruction. Recognition that strontium isotope ratios ($^{87}Sr/^{86}Sr$) could be used to examine past human residence patterns (e.g., Ericson 1985) shifted the perspective of isotope techniques to include mobility. Oxygen isotopes ($\delta^{18}O$) from skeletal phosphate or carbonate have been used extensively by archaeologists to identify prehistoric mobility, as have other isotope systems such as nitrogen ($\delta^{15}N$), lead ($^{204,\ 206,\ 207,\ 208}Pb$), and sulfur ($\delta^{34}S$). In fact, multi-isotope studies are becoming increasingly common. Biogeochemical analysis has also been used with archaeozoological material to investigate mobility of pastoralists, as well as strategies used by hunter-gatherers (see Table 2).

Genetic techniques first investigated variation in discrete biological factors (Cavalli-Sforza et al. 1994). Frequencies of particular alleles, such as ABO blood types, were then visualized geographically. The advent of DNA sequencing and the measurement of mutation rates allowed researchers to add divergence times between populations to this analysis. Cann and colleagues (1987) used differences in mitochondrial DNA (mtDNA) to suggest an African origin for modern humans 100,000 years ago. Improvements in technology allow researchers to focus on genetic diversity in modern populations around the globe.

Human Migration: Bioarchaeological Approaches, Table 2 A sample of research using bioarchaeological methods to understand migration in various world regions

Archaeological questions	Region/locality	Bioarchaeological techniques	References
Dispersal of modern humans	Eurasia	• mtDNA and Y chromosomes • aDNA	Renfrew & Boyle (2000), Weaver & Roseman (2008)
Spread of agriculture	Global	• mtDNA and Y chromosomes • aDNA genetic markers • $^{87}Sr/^{86}Sr$ • $\delta^{18}O$ • Craniometry	Myles et al. (2005), Haak et al. (2008), Pinhasi & von Cramon-Taubadel (2009)
Peopling of the Americas	East Asia Americas	• Craniometry • Dental analysis genetic markers • mtDNA and Y chromosomes	Schurr (2004), Pitblado (2011)
Pastoral mobility	Eurasia	• $^{87}Sr/^{86}Sr$ • $\delta^{18}O$ • $\delta^{13}C$	Bocherens et al. (2001), Balasse et al. (2002)
Lifetime mobility	Eastern Mediterranean	• $^{87}Sr/^{86}Sr$ • $\delta^{18}O$	Mitchell & Millard (2009)
	Imperial Rome		Prowse et al. (2007)
	Bronze Age Britain		Evans et al. (2006)
	Egypt	$\delta^{15}N$ $\delta^{34}S$	Dupras & Schwarcz (2001)
	Mesoamerica	• $^{87}Sr/^{86}Sr$ • Biodistance	Scherer (2007), Price et al. (2008)
New World slave trade	Yucatan Barbados	• $^{87}Sr/^{86}Sr$ • $\delta^{18}O$	Price et al. (2008), Schroeder et al. (2009)
Sacrificial burial	Mesoamerica South America	• $^{87}Sr/^{86}Sr$ • $\delta^{18}O$	White et al. (2007), Tung & Knudson (2008)
Kinship, postmarital residence	Neolithic Europe Thailand American Southwest	• $^{87}Sr/^{86}Sr$ • $\delta^{18}O$ • aDNA	Ezzo et al. (1997), Bentley et al. (2007), Haak et al. (2008)
Identity and social hierarchy	Japan South America	• $^{87}Sr/^{86}Sr$ • $\delta^{18}O$ • $^{206/204}Pb$, $^{207/204}Pb$, $^{208/204}Pb$ • Dental ablation	Kusaka et al. (2009), Turner et al. (2009)

Key Issues

Using Bioarchaeological Techniques to Reconstruct Migration

Archaeologists attempt to situate evidence of past mobility within a larger contextual framework, but the nature and scale of major research questions varies considerably. At the broadest level are questions concerned with transformational dispersals in human history – from hominins leaving Africa to the spread of agriculture – that frequently utilize genetic analysis to elucidate the structure of past human migration and interaction. Conversely, the most specific seeks to understand how mobility articulates with local or regional social processes of economy, identity, and ritual. Research at this scale involves direct analysis of archaeological skeletal remains and may focus on the life histories of specific individuals. Biogeochemical data at this scale only pertain to the period of formation of the sampled skeletal tissue (i.e., period of tooth formation). Table 2 outlines some recent applications of bioarchaeological methods to identify different types of mobility; it is by no means comprehensive, but provides some examples of current research.

Bioarchaeological approaches to migration are currently limited by a number of factors. First, most biodistance studies are based on similarities in morphological traits, which can result from environmental influences as well as shared genes. Incomplete skeletal remains also require estimation of missing data, which may greatly reduce the sample size, a common problem in archaeological studies.

Second, recognition that isotope variability does not necessarily correspond to cultural regions – and that neighboring regions may display similar values – has stimulated debate about the best way to differentiate "local" from "nonlocal" individuals. The potential for diagenetic alteration of archaeological materials also affects both biogeochemical and genetic analyses. Critiques of nearly every study involving aDNA note the possibility that the results include modern DNA, despite efforts by geneticists prevent contamination. Researchers increasingly prefer to sample tooth enamel, which is less subject to alteration in the burial environment. Each study presents different taphonomic and laboratory challenges. One of the best solutions is to use multiple lines of evidence to reconstruct population movement and interpret its meaning. One such example comes from intensive research on a Neolithic mummy in Central Europe that used a combination of bioarchaeological techniques to reconstruct the life history of a single individual.

Case Study: The Tyrolean Ice Man

In 1991, hikers discovered a 5,200-year-old frozen mummy in the Ötzal Alps: who was "Ötzi," and where did he come from? None of the artifacts found with the body could be used to determine his origin, so scientists used isotopic, osteological, and genetic methods to identify Ötzi's homeland and to understand how he lived and how he died.

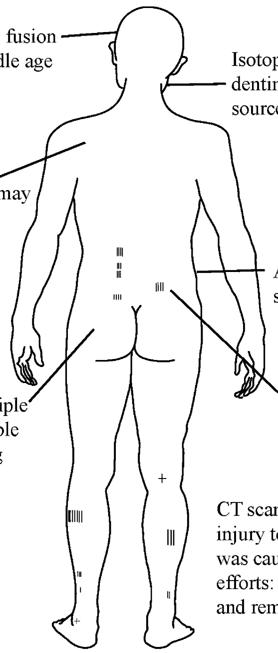
Where did Ötzi live? Strontium, lead, and oxygen isotope values in his bones and teeth show that he probably spent most of his life less than 60 km from his place of death (Müller et al. 2003). Analyses of his last meals, sampled from his intestinal tract, show that he traveled from lower elevations shortly before he died.

Who was he? Ötzi's mtDNA closely resembles that of modern populations living in the Ötzal Alps region (Rollo et al. 2006). Healed rib fractures and skeletal pathologies show that his lifestyle was active and, at times, dangerous (zur Nedden et al. 1994). It is possible that tattoos on his legs, back, and hands were not simply decoration, but evidence of therapeutic treatment for his arthritis and other ailments (Renaut 2004).

Was Ötzi a migrant? Ötzi may have lived in a different village as an adult than as a child, but he was not a long-distance migrant. He may have moved seasonally, or traveled throughout the region as an adult, but he was not far from his place of birth when he died. The circumstances of his death have prompted speculation that he was fleeing his home: an attack shortly before he died left an arrowhead lodged in his shoulder region (Gostner & Vigl 2002) (Fig. 1).

Nearly every possible biogeochemical analysis has been conducted on Ötzi and his belongings, but archaeologists still need contextual information to interpret the results. In this case, there is no burial or site information. Studies conducted on individuals buried in tombs or households provide more in-depth information, especially if written texts also are available.

One example is the life and migration history of the Maya king K'inich Yax K'uk' Mo' from the Classic period site of Copan. Bioarchaeological, isotopic, textual, and archaeological data suggest that he moved multiple times during his life, and that his nonlocal origin was an important factor in his role as ruler. Other migrants have been identified at Copan (Price et al. 2010), as well as other sites in the region, which allows researchers to place this study in a broader regional context and



Human Migration: Bioarchaeological Approaches, Fig. 1 Bioarchaeological techniques used to reconstruct Ötzi's life history (Adapted from Renaut 2004)

to suggest that migration was a common phenomena in the Maya lowlands.

Future Directions

Archaeologists will need increasingly specialized and sophisticated knowledge to be producers of bioarchaeological data. Collaboration with specialists will continue, but archaeologists themselves must gain greater expertise in biogeochemical and genetic techniques to better apply those using anthropological frameworks.

New techniques and isotope proxies also continue to enhance bioarchaeological aims. For example, emergence of 3-dimensional morphometric techniques will refine biodistance analysis (Buikstra & Beck 2006), as well as incorporation of GIS applications (Relethford 2008). Investigation of other isotopes in skeletal material, such as sulfur and lead, may provide new proxies for mobility (e.g., Richards et al. 2001; Müller et al. 2003). Pursuit of more detailed understanding of the nature and scale of isotopic and genetic variation will clarify relationships between biological and environmental variations (e.g., Bentley 2006).

Such advances will prove crucial to archaeological studies of migration in coming years. A more in-depth understanding of the human genome and how genetic markers relate to osteological variability will help to identify migration within human populations. Larger datasets also will prove useful in identifying broader patterns of mobility, and reanalysis of existing collections at archaeological sites and museums will increase. Ultimately, even the most advanced techniques are limited by biology, environmental variability, and the nature of the archaeological record. Even with these limitations, the ability of archaeologists to identify past mobility and place it within a larger social context is stronger than ever.

Acknowledgments We would like to thank the editors of the bioarchaeology section, Drs. Arleyn Simon and Christian Wells, for the invitation, and to all the editorial staff for EGA for the opportunity to contribute. We also thank Dr. James H. Burton and Dr. T. Douglas Price of UW-Madison Laboratory for Archaeological Chemistry for use of the facilities and for thoughtful discussion and guidance, and the Department of Anthropology at UW-Madison for its support. Any misinterpretations, errors, or omissions are our own.

Cross-References

- ▶ African Diaspora Archaeology
- ▶ Archaeology as Anthropology
- ▶ Bioarchaeology in the Roman Empire
- ▶ Bioarchaeology, Human Osteology, and Forensic Anthropology: Definitions and Developments
- ▶ Bioarchaeology: Definition
- ▶ Biological Distance in Bioarchaeology and Human Osteology
- ▶ Bone: Chemical Analysis
- ▶ DNA and Skeletal Analysis in Bioarchaeology and Human Osteology
- ▶ DNA Interpretation Constraints in Archaeology
- ▶ Inductively Coupled Plasma-Mass Spectrometry (ICP-MS): Applications in Archaeology
- ▶ Isotope Geochemistry in Archaeology
- ▶ Isotopic Studies of Foragers' Diet: Environmental Archaeological Approaches
- ▶ Isotopic Studies of Husbandry Practices
- ▶ Peopling of the Americas

References

ANTHONY, D.W. 1990. Migration in archaeology: the baby and the bathwater. *American Anthropologist* 92: 895-914.

ARMELAGOS, G.J. & D.P. VAN GERVEN. 2003. A century of skeletal biology and paleopathology: contrasts, contradictions, and conflicts. *American Anthropologist* 105: 53-64.

BENTLEY, R.A. 2006. Strontium isotopes from the earth to the archaeological skeleton: a review. *Journal of Archaeological Method and Theory* 13: 135-87.

BUIKSTRA, J.E. & L.A. BECK. (ed.) 2006. *Bioarchaeology: the contextual analysis of human remains*. Amsterdam: Academic Press.

BURTON, J.H., T.D. PRICE, L. CAHUE & L.E. WRIGHT. 2003. The use of barium and strontium abundances in human skeletal tissues to determine their geographic origins. *International Journal of Osteoarchaeology* 13: 88-95.

CANN, R.L., M. STONEKING & A.C. WILSON. 1987. Mitochondrial DNA and human evolution. *Nature* 325: 31-6.

CAVALLI-SFORZA, L.L., P. MENOZZI & A. PIAZZA. 1994. *The history and geography of human genes*. Princeton (NJ): Princeton University Press.

ERICSON, J.E. 1985. Strontium isotope characterization in the study of prehistoric human ecology. *Journal of Human Evolution* 14: 503-11.

GOSTNER, P. & E.E. VIGL. 2002. INSIGHT: report of the radiological-forensic findings on the iceman. *Journal of Archaeological Science* 29: 323-26.

KNUDSON, K.J. & C.M. STOJANOWSKI. (ed.) 2009. *Bioarchaeology and identity in the Americas*. Gainesville: University Press of Florida.

MÜLLER, W., H. FRICKE, A.N. HALLIDAY, M.T. MCCULLOGH & J. WARTHO. 2003. Origin and migration of the Alpine Iceman. *Science* 302: 862-66.

PRICE, T.D., J.H. BURTON, P.D. FULLAGAR, R.S. SHARER, J.E. BUIKSTRA, L.E. WRIGHT, L.P. TRAXLER & K.A. MILLER. 2010. Kings and commoners at Copan: isotopic evidence for origins and movement in the Classic Maya period. *Journal of Anthropological Archaeology* 29: 15-32.

RELETHFORD, J.H. 2008. Geostatistics and spatial analysis in biological anthropology. *American Journal of Physical Anthropology* 136: 1-10.

RENAUT, L. 2004. Las tatuages d'Otzi et la petite chirgurie traditionelle. *L'Anthropologie* 108: 69-105.

RICHARDS, M.P., B.T. FULLER & R.E.M. HEDGES. 2001. Sulfur isotopic variation in ancient bone collagen from Europe: implications for human palaeodiet, residence mobility, and modern pollutant studies. *Earth and Planetary Science Letters* 191: 185-90.

ROLLO, F., L. ERMINI, S. LUCIANI, I. MAROTA, C. OLIVIERI & D. LUISELLI. 2006. Fine characterization of the Iceman's mtDNA haplogroup. *American Journal of Physical Anthropology* 130: 557-64.

ROUSE, I. 1986. *Migrations in prehistory: inferring population movement from cultural remains*. New Haven: Yale University Press.

TRIGGER, B.G. 2006. *A history of archaeological thought* (2nd edition). Cambridge: Cambridge University Press.

ZUR NEDDEN, D., K. WICKE, R. KNAPP, H. SEIDLER, H. WILFING, G. WEBER, K. SPINDLER, W. MURPHY, G. HAUSER & W. PLATZER. 1994. New findings on the Tyrolean "Ice Man": archaeological and CT-body analysis suggest personal disaster before death. *Journal of Archaeological Science* 21: 809-18.

Further Reading

BALASSE, M., S.H. AMBROSE, A. SMITH & T.D. PRICE. 2002. The seasonal mobility model for prehistoric herders in the Southwestern Cape of South Africa assessed by isotopic analysis of sheep tooth enamel. *Journal of Archaeological Science* 29: 917-32.

BENTLEY, R.A., N. TAYLES, C. HIGHAM, C. MACPHERSON & T.C. Atkinson. 2007. Shifting gender relations at Khok Phanom Di, Thailand: isotopic evidence from the skeletons. *Current Anthropology* 48: 301-14.

BOCHERENS, H., M. MASHKOUR, D. BILLIOU, E. PELLÉ & A. MARIOTTI. 2001. A new approach for studying prehistoric herd management in arid areas: intra-tooth isotopic analyses of archaeological caprines from Iran. *Earth and Planetary Sciences* 332: 67-74.

DUPRAS, T.L. & H.P. SCHWARCZ. 2001. Strangers in a strange land: stable isotope evidence for human migration in the Dakhleh oasis, Egypt. *Journal of Archaeological Science* 28: 1199-1208.

Evans, J.A., C.A. Chenery & A.P. Fitzpatrick. 2006. Bronze age childhood migration of individuals near Stonehenge, revealed by strontium and oxygen isotope tooth enamel analysis. *Archaeometry* 48: 309-21.

Ezzo, J.A., C.M. Johnson & T.D. Price. 1997. Analytical perspectives on prehistoric migration: a case study from east-central Arizona. *Journal of Archaeological Science* 24: 447-66.

Haak, W., G. Brandt, H.N. de Jong, Ch. Meyer, R. Ganslmeier, V. Heyd, A.W.G. Pike, Ch. Hawkesworth, H. Meller & K.W. Alt. 2008. Ancient DNA, strontium isotopes, and osteological analyses shed light on social and kinship organization of the Later Stone Age. *Proceedings of the National Academy of Sciences of the United States of America* 105: 18226-31.

Kusaka, S., A. Ando, T. Nakano, T. Yumoto, E. Ishimaru, M. Yoneda, F. Hyodo & K. Katayama. 2009. A strontium isotope analysis on the relationship between ritual tooth ablation and migration among the Jomon people in Japan. *Journal of Archaeological Science* 36: 2289-97.

Mitchell, P.D. & A.R. Millard. 2009. Migration to the medieval Middle East with the crusades. *American Journal of Physical Anthropology* 140: 518-25.

Myles, S., N. Bouzekri, E. Haverfield, M. Cherkaoui, J.-M. Dugoujon & R. Ward. 2005. Genetic evidence in support of a shared Eurasian-north African dairying origin. *Human Genetics* 117: 34-42.

Pinhasi, R. & N. von Cramon-Taubadel. 2009. Craniometric data supports demic diffusion model for the spread of agriculture into Europe. *PLoS One* 4: e6747.

Pitblado, B.L. 2011. A tale of two migrations: reconciling recent biological and archaeological evidence for the Pleistocene peopling of the Americas. *Journal of Archaeological Research* 19: 327-75.

Price, T.D., J.H. Burton, P.D. Fullagar, L.E. Wright, J.E. Buikstra & V. Tiesler. 2008. Strontium isotopes and the study of human mobility in ancient Mesoamerica. *Latin American Antiquity* 19: 167-80.

Prowse, T.L., H.P. Schwarcz, P. Garnsey, L. Bondioli, R. Macchiarelli & M. Knyf. 2007. Isotopic evidence for age-related immigration to imperial Rome. *American Journal of Physical Anthropology* 132: 510-19.

Renfrew, C. & K.V. Boyle. (ed.) 2000. *Archaeogenetics: DNA and the population prehistory of Europe* (McDonald Institute Monographs). Cambridge: McDonald Institute for Archaeological Research.

Scherer, A.K. 2007. Population structure of the classic period Maya. *American Journal of Physical Anthropology* 132: 367-80.

Schroeder, H., T.C. O'Connell, J.A. Evans, K.A. Shuler & R.E.M. Hedges. 2009. Trans-Atlantic slavery: isotopic evidence for forced migration to Barbados. *American Journal of Physical Anthropology* 139: 547-57.

Schurr, T.G. 2004. The peopling of the New World: Perspectives from molecular anthropology. *Annual Review of Anthropology* 33: 551-83.

Tung, T.A. & K.J. Knudson. 2008. Social identities and geographical origins of Wari trophy heads from Conchopata, Peru. *Current Anthropology* 49: 915-25.

Turner, B.L., G.D. Kamenov, J.D. Kingston & G.J. Armelagos. 2009. Insights into immigration and social class at Machu Picchu, Peru based on oxygen, strontium, and lead isotopic analysis. *Journal of Archaeological Science* 36: 317-32.

Weaver, T.D. & C.C. Roseman. 2008. New developments in the genetic evidence for modern human origins. *Evolutionary Anthropology* 17: 69-80.

White, C.D., T.D. Price & F.J. Longstaffe. 2007. Residential histories of the human sacrifices at the Moon Pyramid, Teotihuacan. *Ancient Mesoamerica* 18: 159-72.

Human Remains in Museums

Cressida Fforde
National Centre for Indigenous Studies,
The Australian National University,
Canberra, ACT, Australia

Introduction

Human remains have long been acquired for study and display in public and private museums and those of universities and learned societies worldwide. They are today to be found in a range of collections, but particularly those associated with anatomy and the medical sciences, archaeology, anthropology, ethnography, and natural history. They have also, historically, been located in phrenology museums and were subject to acquisition as curios whether within small private collections or the larger cabinets of curiosity compiled by prominent individuals and monarchs of renaissance Europe. The contents of some of these curiosity cabinets are now to be found in museums today, and indeed sometimes formed the basis of their initial collections.

Definition

All types of human remains have been acquired by museums, including ancient and modern