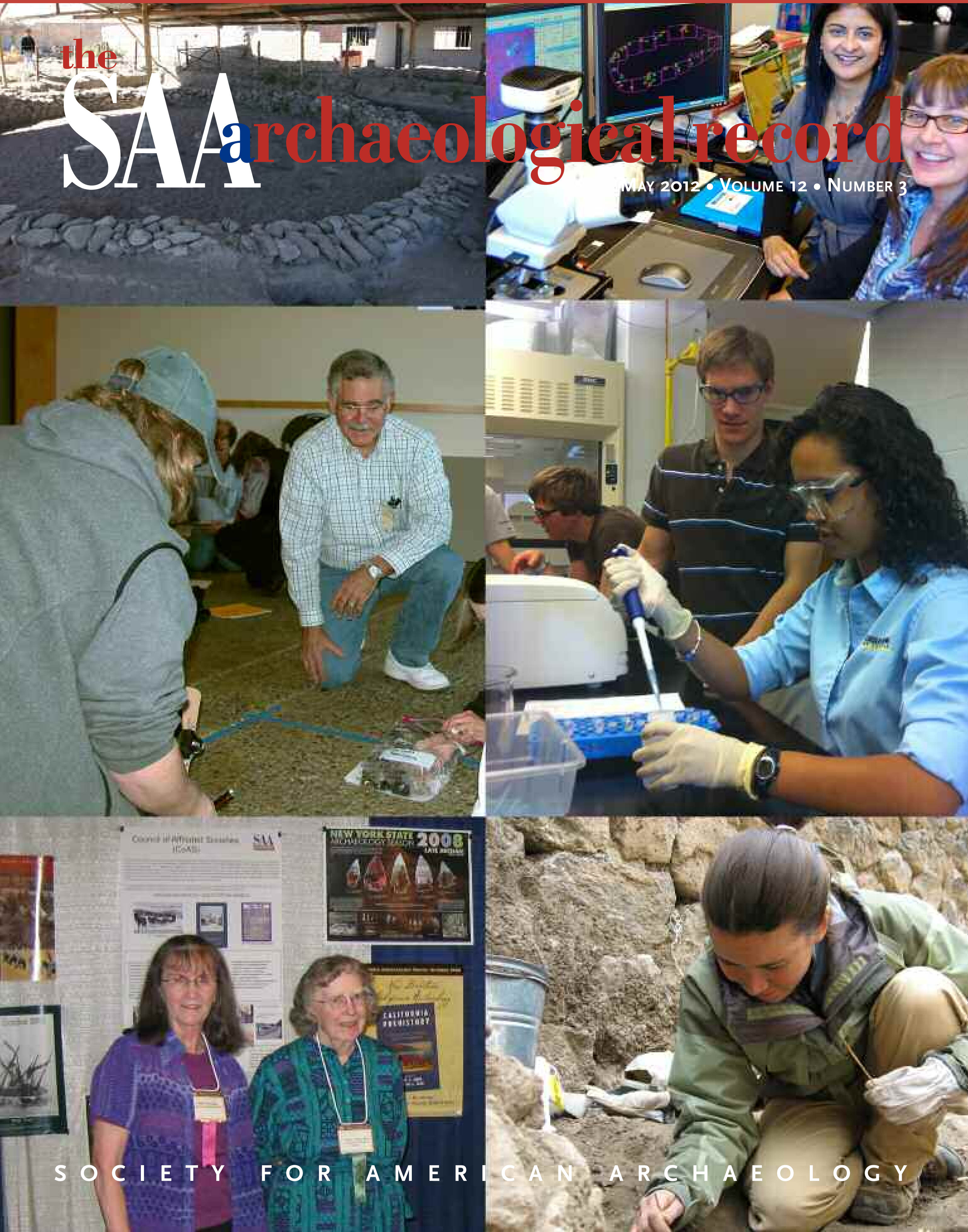
NEW DIRECTIONS IN BIOARCHAEOLOGY, PART II

78TH ANNUAL MEETING SUBMISSIONS DEADLINE: SEPTEMBER 12, 2012.

the SAA archaeological record

MAY 2012 • VOLUME 12 • NUMBER 3



SOCIETY FOR AMERICAN ARCHAEOLOGY

THE BIOARCHAEOLOGY OF MIGRATION

Tiffiny Tung

Tiffiny A. Tung is a Professor at the Department of Anthropology, Vanderbilt University.

Settling in a new land with different landscapes and food choices, strange customs, and unfamiliar people can be an overwhelming experience filled with challenges and opportunities, and this holds true for immigrants of today and the distant past. My father, who emigrated from China as a young adult, along with his mother and siblings, tells of sailing under the Golden Gate Bridge on Thanksgiving Day in 1951. Friends met them at the port and took them to a traditional Thanksgiving dinner—turkey, potatoes, pies, the works. "America really is the land of plenty!" To their chagrin, they eventually learned that Americans didn't feast like that every day, but they were still overwhelmed by the new foods. Over time, my family's diets and palates changed, and so too did the chemical make-up of their bones. Though undetected by them, their strontium, carbon, and nitrogen isotope ratios were changing by virtue of their newly consumed food and drink. Fortunately for bioarchaeologists, we can detect dietary changes through isotope testing and use that information to identify immigrants at archaeology sites and examine how immigrants differed from locals in terms of health and lived experience.

Throughout time, immigration and forcible relocation, as in slavery, abductions, and human trafficking (see Martin and Osterholtz, this issue) has led to major transformations in demography and cultural practices for both local and nonlocal groups, and it can contribute to new kinds of hierarchies. These can lead to very different life experiences and health outcomes for the foreigners and locals. Thus, a goal of a bioarchaeological study of migration (and foreigners, more generally) is to explore how that "outsider" status may have shaped one's heath. Did outsiders suffer poorer health relative to the locals? My aunt, for example, suffered from tuberculosis shortly after her arrival to the U.S. and was placed in a tuberculosis sanitarium where she eventually recovered. She likely contracted the disease on the crowded 19-day ocean journey in the bottom level of the ship. That particular immigrant experience shaped other aspects of her health, both short and long term. Did immigrants of the distant past also have greater risks for disease? How else did their experiences differ from the locals? And importantly, how can we detect immigrants in a skeletal sample?

Trophy Heads and Strontium Isotope Analysis

I became interested in using bioarchaeological techniques to identify foreigners and examine their health profile in my study of the Wari Empire (A.D. 600–1000) from the central, highland Peruvian Andes. I, along with my colleague Kelly Knudson, used strontium isotope analysis to determine whether human trophy heads from the site of Conchopata were local or foreign (Tung and Knudson 2011). Wari iconography depicted Wari warriors carrying trophy heads, but it was unclear if they were the heads of (local) venerated ancestors or foreign enemies (Figure 1).

Before I describe our findings, I briefly explain some basic tenets of strontium isotope analysis, which is a technique that can help establish whether a person is from the area where they were buried (i.e., local or foreign). Various levels of strontium isotopes are found in different types and ages of bedrock, and because those vary in the Andes (and other world regions), we can estimate whether a person grew up in a particular geological zone. The ratio between ^{87}Sr and the stable ^{86}Sr ($^{87}Sr/^{86}Sr$) is constant as it moves through the food chain. Thus, the bedrock and soil, the plants grown in that soil, and the animals and humans that eat those plants all have the same strontium isotope ratio. As Douglas Price and colleagues (Price et al. 1994) first demonstrated in their study of a Southwest population at Grasshopper Pueblo, this makes it an ideal technique for determining whether an individual is from a particular region. If the strontium isotope ratio obtained from a skeleton is distinct from that of the local area, then the person is likely a foreigner.

Local strontium isotope ratios can be determined by testing

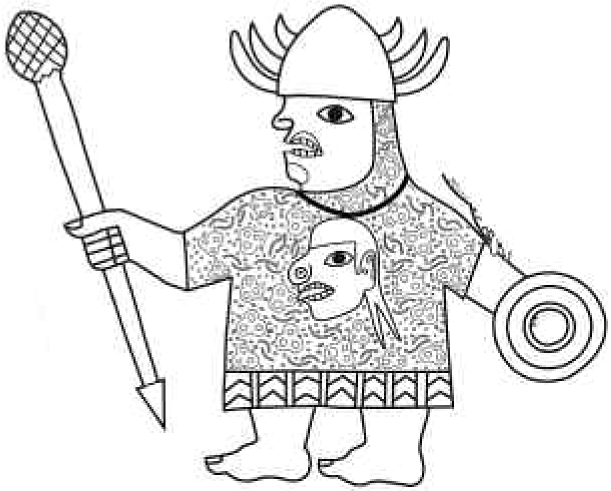


Figure 1: Wari warriors wearing trophy heads appear on enormous ceramic vessels from ritual buildings at Conchopata. It was unclear whether the trophy head was from a local venerated ancestor or a foreign enemy until strontium isotope analysis was conducted.

local soils and archaeological samples of local small animals that don't range far and wide (i.e., they eat only locally grown foods). Comparing the strontium isotope ratio in teeth and bones provides further distinctions, revealing whether childhood was spent in one locale and adulthood in another.

Because teeth form in the early years, the strontium (and other) isotopes from a child's food source are forever "locked" into the dental enamel. In contrast, bone is constantly remodeling, so strontium isotope ratios obtained from bone reveal the geological locale of one's food source in the last few to 10 years of life, depending on which bone is sampled. My father, for example, should have strontium isotope ratios in his teeth that match the soils of their family farm near Chongqing in Sichuan province, China, and his bones should reveal the mixed source of foods in his adult diet.

At the Wari site, we determined the local strontium isotope ratio with local soil and local, modern guinea pigs that consumed local foods. Results showed that the burials under house structures were local—as expected—and that the vast majority of trophy heads from ritual structures were foreign.

This, along with iconographic data that depicted Wari warriors carrying bound prisoners and trophy heads, further confirmed that the trophy heads were foreign captives brought back to the site for sacrifice and transformation into war trophies. After identifying the locals and foreigners, questions about differences in health profiles and exposure to violence could be addressed. The mostly foreign trophy heads exhibited slightly more violence-related cranial trauma than did the locals and significantly more *cribra orbitalia*, a lesion on the orbital roof indicative of general physiological stress (Tung 2012). This suggested that these two groups, who differed by place of origin, had quite distinct lifeways.

Body Modification and Strontium Isotope Analysis

In some regions, the study of body modification practices can be used to differentiate locals and foreigners. My great-aunt was an obvious foreigner—her tiny, bound feet marked her, and many other Chinese women, as foreign-born in the Bay Area where many Chinese settled. In the ancient Andes, it was the head, not the feet, which visibly marked people's place of origin. At the urban center of Tiwanaku in highland Bolivia, occupied in the sixth to eleventh centuries A.D., Deborah Blom identified nonlocals based on cranial modification styles (Blom 2005). Reshaping of the skull must occur in infancy when the bones are malleable, so this bodily

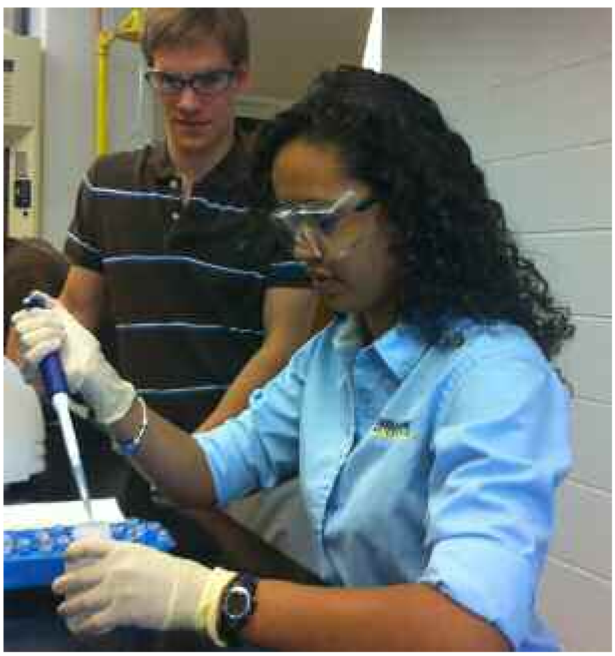


Figure 2: Students who collaborate with Tiffiny Tung are preparing dental enamel samples in the Isotope Laboratory in the Department of Earth and Environmental Sciences at Vanderbilt University. Students are Jasmine Kelly (Martin Luther King Jr. High School) and Jared Sninsky (Vanderbilt University).

Figure 3: The ritual room from where human trophy heads were recovered at the Wari site of Conchopata, Peru.

marker of identity was imposed early in life by parents or other community members, forever marking one's cultural affiliation. Blom found that local, highland populations elongated the skull, making it slope upward, while nonlocals flattened the skull from front to back (known as fronto-occipital modification), and both types were observed at Tiwanaku, suggesting that it was a cosmopolitan center with diverse populations residing there (or at least being buried there).

Blom's findings were further tested by Kelly Knudson and colleagues (Knudson et al. 2004) using strontium isotope analysis, which showed that three out of ten sampled individuals were foreign (Knudson et al. 2004). However, all three had been previously identified as dedicatory offerings based on associated artifacts and their burial in a ceremonial complex (Couture and Sampeck 2003). Thus, it is unclear whether they represent voluntary migrants who settled at the urban center and assimilated into Tiwanaku society or whether they were people or ancestral mummy bundles abducted specifically for use as dedicatory offerings. Nonetheless, the cranial modification and strontium isotope data show that Tiwanaku was an urban and ceremonial center used by people from diverse areas, in some cases as a new residential destination and for others as a final mortuary and ceremonial resting place.

Patrilocality vs. Matrilocality

Bioarchaeological techniques can also be used to investigate gender-based migration patterns. If sex-based differences in migration are detected, then it may be possible to reconstruct community organization as it relates to rules of marriage. At Conchopata, mentioned above, the strontium isotope ratios from the "normal burials" (i.e., not trophy heads) showed that men and women were local, suggesting regional endogamy.

Across the globe, at a Late Stone Age (~4,500 years ago) site near Eulau, Germany, Wolfgang Haak and colleagues (Haak et al. 2008) found that male and child burials had strontium isotope ratios expected for the local region, while the adult females did not. Thus, they suggest that this group practiced exogamy, and that they were patrilocal: nonlocal females moved to the male's residence and then had and raised children in the local area. This would explain why the males and children had local strontium isotope ratios and the females did not.

I, along with my colleague Steve Wernke, are examining similar research questions at an Inka and early Spanish colonial site in southern, highland Peru, where male and female burials have been excavated from Inka-era burial towers (A.D. 1450–1532) and a colonial chapel (A.D. 1540–1575) (Figure 4). The two waves of colonialism—first Inka, then Spanish—may have altered marriage practices in that peripheral region.

Figure 4: Tiffiny Tung excavating human burials at the Inka and early Spanish colonial site of Malata in southern, highland Peru.

Modern Applications of the Bioarchaeology of Migration

According to the Pew Hispanic Center, there were an estimated 11.2 million people identified as "illegal immigrants" in the U.S. in 2010. Sadly, many people die trying to enter the U.S. without detection, whether on crowded ships from Asia or crossing the desert from Mexico. Those who die at the Mexico-U.S. border are often unidentified, their bodies never claimed. The majority come from Latin America, especially Mexico, and bioarchaeological techniques are helping to identify those unclaimed corpses. While DNA testing is one method of identification, it requires that family members reveal that a loved one attempted to cross the border and that they give a sample for DNA testing, requirements that leave many silent. Strontium isotope analysis, in contrast, can be used to narrow down the regions from where a migrant came without asking family members to identify themselves or necessarily give bio-specimens. Chelsey Juarez (Juarez 2008) has been creating a modern strontium isotope map of Mexico by analyzing teeth of Mexican immigrants whose birth locations are known, and she has identified three distinct regions thus far: (1) Mexico City; (2) Jalisco and Guanajuato; and (3) Michoacan. She then examines the strontium isotope ratios of teeth from corpses found at the border to see if they match any of the known regions in Mexico. As she continues to document the strontium isotope ratios from other regions in Mexico and Latin America, her work is providing an important first step in identifying a deceased person's place of origin. This will increase the likelihood of a positive identification, so once-unidentified bodies can be repatriated to the family for mourning and proper burial rites.

In the investigation of migration patterns in the past and present, bioarchaeological methods provide reliable ways to detect the movement of people across the landscape. These studies can then help to clarify our understandings of what motivates a person to leave a land with known kith and kin for a strange, new place filled with odd customs, unintelligible languages, and total strangers. Although that journey may sometimes lead to death, violence, or a compromised state of health, problems in one's homeland and/or the allure of novel economic opportunities, possible marriage partner, among other benefits, have and will continue to motivate people to migrate to new lands.

References Cited

Blom, Deborah E.
2005 Embodying Borders: Human Body Modification and Diversity in Tiwanaku Society. *Journal of Anthropological Archaeology* 24(1):1-24.

Couture, N., and K. Sampeck
2003 Putuni: A History of Palace Architecture at Tiwanaku. In *Tiwanaku and Its Hinterland: Archaeology and Paleoecology of an Andean Civilization*, edited by Alan L. Kolata, pp. 226-263. Urban and rural archaeology. vol. 2. Smithsonian Institution Press, Washington, D.C.

Haak, Wolfgang, Guido. Brandt, Hylke N. de Jong, Christian Meyer, Robert Ganslmeier, Volker Heyd, Chris Hawkesworth, Alistair W. G. Pike, Harold Meller, and Kurt 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 Science* 105(47):18226-18231.

Juarez, Chelsey
2008 Strontium and Geolocation, the Pathway to Identification for Deceased Undocumented Mexican Border-Crossers: A Preliminary Report. *Journal of Forensic Science* 53(1):46-49.

Knudson, K., J., T. D. Price, J. E. Buikstra and D. Blom, E.
2004 The Use Of Strontium Isotope Analysis To Investigate Tiwanaku Migration And Mortuary Ritual in Bolivia and Peru. *Archaeometry* 46:5-18.

Price, T. Douglas, Clark M. Johnson, Joseph A. Ezzo, Jonathan Ericson, and James H. Burton.
1994 Residential Mobility in the Prehistoric Southwest United States: A Preliminary Study Using Strontium Isotope Analysis. *Journal of Archaeological Science* 21:315–330.

Tung, Tiffiny A.
2012 *Violence, Ritual, and the Wari Empire: A Social Bioarchaeology of Imperialism in the Ancient Andes.* University Press of Florida, Gainesville.

Tung, Tiffiny A., and Kelley J. Knudson
2011 Identifying Locals, Migrants, and Captives in the Wari Heartland: A Bioarchaeological and Biogeochemical Study of Human Remains from Conchopata, Peru. *Journal of Anthropological Archaeology* 30:247–261.