4 What's In These Bones? The Bioarchaeology Of Me

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As a follow up to Helen Mackie's self-completed osteological report (2010) in our last issue, I will attempt to assess what future archaeologists might conclude about me from the molecules in my bones and teeth using current techniques. Like Mackie's article (2010), this is not an outlet to feed some narcissistic tendencies I may harbor, but a brief discourse of lessons learned over my university career as well as a medium to air some ideas that have struck me during seminars and pub sessions with fellow archaeology students. I will talk about stable isotope analysis, as well as venture into possible DNA studies. But first, I must begin with an introduction of myself.

I hail from a tiny island in the middle of the South Pacific. I am very proud to have been born and raised on the island of Guam, an American territory since 1898. When I turned 18, I flew to England, which for the last two years, has been home. These two facts are very important for the first method I will discuss stable isotope analysis.

When assessing the diets and migrations of the past, bioarchaeologists often turn to stable isotopes to discern what types of food the individuals were consuming. In addition to this data, information about movement from one area to another may be gleaned and interpreted. Frequently employed are the strontium, oxygen, nitrogen, and sulphur isotopes (Price et al. 2002; Richards et al. 2001). These isotopes are taken into the body via food and water consumption (Schroeder et al. 2009), and are incorporated into teeth and bone collagen matrices. This isotopic signature will remain in the bone collagen for around 5-10 years. Teeth give insight into a limited period of an individual's life, as teeth are formed in youth and are not subject to mineral turnovers like bone and are less likely to experience post-mortem contamination. Therefore, when studying teeth, bioarchaeologists are wary to note that they are examining the individual's childhood and perhaps young adulthood.

Oxygen and strontium mainly divulge information about an individual's movement (Schroeder et al. 2009). Strontium is present in the underlying geology of a region, taken up into the soil from the bedrock and transferred into plants and groundwater. As geologies vary from region to region, strontium signals also vary according to the age of the bedrock (Bentley, 2006). Oxygen, on the other hand, is varied because of the differences in precipitation (a complicated system of preferential uptake of lighter oxygen molecules into the atmosphere and distance from the sea (Gat 1996)). However, it is important to note that while individuals in a population can be singled out as interlopers, their place of origin is difficult to pinpoint due to the widely separate but geologically similar geographical areas (Schroeder et al. 2009).

Nitrogen and carbon enter the body through food. Nitrogen measures the trophic level of ingested food, thus leading to knowledge of terrestrial and marine food chains (Schroeder et al. 2009). Carbon isotopes also map this difference in resource-exploitation, but also enable studies of what type of plants were consumed via the identification of two types of carbon pathways (C3 and C4). Sulphur, according to Richards et al. 2001, can be used to measure both diet-resource origin and migratory patterns.

Now, this is all well and good in a past where food resources were assumed to not be as globally transmitted as they are today. Using human hair, studies on modern diets and the stable isotopes captured in the keratin have produced very interesting results (Chesson et al. 2008 and Ehleringer et al. 2008), but what does this out-sourcing of food mean for future archaeologists trying to discover my dietary intake?

Majority of the food on Guam is imported: quite a lot of the beef is from Australia, the jasmine rice that was staple to my childhood diet was usually from Thailand, and the corn, the only "vegetable" my father could bribe me to eat, was canned somewhere in the mid-western United States. In terms of identifying my dietary intake as a child, I am quite confident in saying that future bioarchaeologists can examine the mass-spectrometry results and conclude that I ate an exorbitant amount of terrestrial-based meat and plants with a slight indication of the maize I consumed. However, if I die and am buried in England, would they be able to tell I was an expatriate?

I would hope so, but in addition to the imported food from geologically varied regions, bottled water is also imported. In an attempt to not discuss the problems plaguing Guam's waterworks infrastructure, I will hope the reader finds it suffice when I say that the tap water in Guam is not always a reliable drinking source. Therefore, dependent on what kind of water my parents chose from the supermarket, as well as the later introduction of UV purification systems (which has been demonstrated to alter the oxygen isotopic levels in favor of the lighter molecule; Courbon et al. 1977), this seemingly straightforward analysis may just make the picture even blurrier. Perhaps sulphur would be the best isotope to identify my migration, as Guam in 2003 experienced waves of sulphuric ash coming from Mt. Anatahan, an active volcano on an island 320 km north of Guam. Surely this increased exposure would be recorded in my wisdom teeth, as they do not stop growing until somewhere in my early twenties (Scheid 2007), and place me as an outlier in an English cemetery sample.

Sampling of my postcranial bones might begin to hint at a change in diet and location, through evolution of food preferences and tap water intake, but if we were to assume for the sake of this article that I died tomorrow and was buried within the week, the last two years of my British-based consumption may not leave a noticeable signal in my bones.

Yet, perhaps my future investigators may find that a conclusion about my biomolecular history would be best served with DNA analysis. In archaeological sampling, mitochondrial DNA (mtDNA) is preferred, simply because of the number of copies that exist equate to the increased likelihood of DNA survival in a deposited bone. This set of DNA is actually useful for population studies as it can possibly relate individuals in a population to each other through maternal lineages (Salas et al. 2005). However, this is the limitation with the use of mtDNA: the history told follows one line of women, and ignores all other contributors to the person's genetic inheritance. This said, modern Y-chromosomes are beginning to be further explored (Hnemeier et al. 2007) and in the future we may begin see a paternal counterpart in investigations of the past. However, this is severely limited by the survival rate of nuclear DNA in ancient bone samples. It is worth mentioning that techniques are increasingly becoming more reliable and effective, and the analysis of Neanderthal nuclear genome was recently published (Green et al. 2010).

Unfortunately I do not carry a Y-chromosome, thus am a female and therefore would not provide such interesting information about my father's legacy. Despite this, I am sure that analysis of both sets of DNA might shed some interesting light on my life history. My mother's family is originally from the Philippines, and despite her mother's mixed heritage (a true mestiza), her mitochondrial DNA is most likely to be grouped with other similar mitochondrial genomes from Southeast Asia. However, my father is of Caucasian descent, his ancestors migrating to the United States from various countries in Europe. As such, I would expect my nuclear DNA to carry markers from both populations, with the Spanish admixture adding even more confusion. While my Southeast Asian mtDNA might indicate that I am a migrant, in these times of easy mass-migrations of people from one corner of the globe to another it may not be surprising. If anything, I could be falsely identified as sharing close relations to those other carriers of Southeast Asian mitochondrial DNA and we would be grouped together as a single unit of migrants, when truthfully I come from an entirely different socio-political background.

To conclude, this self-analysis of the molecules that form my physical self is interesting in that it provides a different perspective to how remains should be treated and interpreted, as well as an awareness of the difficulty our future successors will encounter when trying to analyse the diets and migrations of a globally connected and technological advanced society. I am guilty, at times, of treating skeletons as "specimens" and examining them through cold lenses, when really those bones and whatever information they offer were once living, breathing people, made of flesh and blood, with complex life stories that we can only begin to imagine and piece together incompletely. For the future archaeologists, who for one reason or another, decide that our time is one of interesting study and expose my bones from the grave, I only wish them luck in their attempts to understand my life through my diet and genetic composition as it is sure to be rife with lots of confusing details.

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