Podcast interview with Matt Sponheimer

**PNAS:** I’m your host Nicholette Zeliadt, and welcome back to Science Sessions. Changes in the diets of our distant evolutionary cousins, the early hominins, are thought to be one of the driving forces in human evolution. Matt Sponheimer, a professor of anthropology at the University of Colorado, Boulder, investigates the diets of early hominins by analyzing the stable isotopes present in fossilized teeth. Such isotopes are naturally present in food and become incorporated into the growing teeth and bones of animals as they eat. Sponheimer and colleagues recently published a series of papers in PNAS that analyzed the carbon isotopes in fossilized teeth from hominins and baboons in Africa between 4 million and 10,000 years ago. I caught up with Sponheimer at the spring meeting of the American Chemical Society in New Orleans. He begins by explaining the rationale for this work.

**Sponheimer:** My research is based upon the premise that you are what you eat—the idea that the carbon atoms in your plant foods ultimately become incorporated in your body. So the idea is that if there’s something we want to know about ancient diet, we can often go to the fossilized teeth—teeth are more or less pre-fossilized, which makes them really amenable to this kind of analysis—and get these ancient traces of meals, and hopefully reconstruct ancient hominin menus. Of course, it’s more complicated than that. The carbon isotopes are particularly interesting because in African savannahs, you tend to have trees, bushes, and therefore most of the fruits and things that are available, use C3 photosynthesis. This is quite distinct in the carbon isotope composition from things like tropical grasses and some sedges that utilize C4 photosynthesis. Therefore we can very readily distinguish between animals that ate mostly tree products versus those that were engaging more broadly with the open parts of savannah environments—eating grasses, eating sedges, or eating animals that are eating those products.

**PNAS:** Sponheimer and colleagues reported that around 3.5 million years ago, the diets of early hominins diverged from those of other closely related primates.

**Sponheimer:** I guess the short version of this all is that, early hominins are diverse. There’s no really such a thing as early hominin diet. If you go back to about 4 million years, everything that we have at this point looks like, well it’s a C3 value, so the kind of thing we see with contemporary chimpanzees, no matter what environment they’re in. However, by about 3.5 million years, we see this new engagement with likely C4 resources, and we also see high variation that you never see in chimpanzees today. It seems like a different kind of engagement with the different types of vegetation out there in the landscapes, a broader one. Some people would want to read this as a very broadly generalist adaptation. But then another interesting thing happens. You get a certain
group of organisms that are all the way out on the C4 end. They look more like zebras than they do like most primates. It’s a really bizarre thing to see in primates. And frankly, not many people expected that we’d find such things.

**PNAS:** Sponheimer explains how these findings fit into the larger picture of human evolution.

**Sponheimer:** I think right now, we’re at a very interesting juncture. Because we know that, our traditional stories about the opening of the landscape, and the changing in the masticatory apparatus to deal with changing dietary resources in the landscape, well we have now some evidence of that in the carbon isotope composition. Over time, we see the teeth get bigger and these hominins seem to be eating more C4 vegetation, or animals eating C4 vegetation. So that’s kind of a nice story—you can make environment, hominin morphology, and the isotopes all work together. But that also is overly simplistic. We still don’t know what these C4 resources were. And that’s a not inconsiderable deficit in our knowledge. If they were eating grasses, well that tells us something pretty dramatic about what these hominins were doing. They’re interacting with this huge grazing herbivore guild in ways that, frankly, most of us didn’t imagine. What if they were eating C4 animal foods, as some people would like to believe? Well then that suggests that they’re competing with the carnivore guild. They’re going to deal with different kinds of predator pressures. They’re probably utilizing the landscape in very different ways. Or what if, as some people would like, they’re eating C4 sedges? Well, if they’re eating C4 aquatic sedges, at least, that suggests they’re near water courses. And that suggests that they would have been in relatively limited areas of the landscape compared to many of the other mammals out there. So, I think we’re at this fascinating moment where we all of the sudden have a completely new wonderful data set there. We don’t understand it yet, but we do know that there are a lot of problems with what we thought. And I’m really looking to the next few years where a variety of people engage in these issues of paleoanthropology, whether or not they’re interested in the morphology, the anatomy of these organisms, things like dental microwear, various people who are interested in archaeological evidence. We can all get together at the table and really integrate our data in novel ways. I think it’s about time, and it’s going to teach us a great deal about who we are and how we came to be.

**PNAS:** Thanks for listening. You can find more Science Sessions podcasts at PNAS.org.