The human family tree is full of dead branches, cousins to us modern humans that went nowhere. What enabled our kind, *Homo sapiens*, to arise and persist? Rick Potts, a paleoanthropologist at the Smithsonian Institution, sees evidence that early humans were adapted to change itself, specifically the frequent and severe environmental changes that occurred in Africa and elsewhere beginning around 800,000 years ago. In this interview with anthropologist Graham Townsley conducted at Potts's research site at Olorgesailie in Kenya, Potts talks about how he came to this way of thinking, what pigments found at the site say about our evolution, and why the jury is still out on how successful *Homo sapiens* really is.

Editor's note: Olorgesailie is an early human site in southern Kenya first discovered by Louis and Mary Leakey in the 1940s. Since the early 1980s, Potts, Director of the Human Origins Program at the National Museum of Natural History, has been excavating the site, which is noted for its large number of handaxes made by *Homo erectus* between 600,000 and one million years ago.

Dr. Rick Potts holds one of 500 handaxes made by *Homo erectus* that he and his team uncovered at his research site at Olorgesailie, Kenya.

BIRTH OF AN IDEA

What was it that originally led you to formulate the climate variability hypothesis?

Climate change had always been on people's minds when it came to human evolution. The idea that was around for a long time is that the establishment of a savanna environment, the grassy environment with a few trees, was critical to human evolution early on, and that and the Ice Age later on presented the challenging environment in which humans evolved.

But when I began the work here at Olorgesailie, we kept seeing layer after layer of environmental change, from soils to volcanic ashes to a lake to a drought when the lake completely evaporated. We saw this through 700,000 years, and I began to think, well, maybe it's not the particular environment of a savanna that was important, but the tendency of the environment to change, to vary in very dramatic ways. And we saw that the large grazing animals of the savanna—elephants, baboons, pigs, zebras, all of whom ate grass—disappeared in the time period when worldwide climate began to vary the most.

So it dawned on me: Rick, you're an anthropologist. Maybe this has something to do with human evolution, and it's not the survival of the fittest in any one environment but the survival of the more versatile, the more general and flexible creatures that would really persist over time. This gave me a new insight into human evolution. The origin of stone tools, the expansion of the
brain, and the complexity of social life that we see with the emergence of our own species may actually be a response not just to the dry savanna or the cold Ice Age but to the wide and dramatic variability of climate over time.

*We have not yet proven whether we can be as successful even as Homo erectus.*

How condensed could these periods of climate variability be?

In some cases the landscape change occurred within a few thousand years. But this is all within a larger cycle of changing—Earth's orbit around the sun, and changes from wet to dry in tropical Africa, and, later in time, changes that were on a scale of 100,000 years between ice ages and interglacial warmth.

So you were able to correlate these periods of intense climate variability with the important steps in human evolution?

Olorgesailie inspired our idea that climate variability was an important driving force in human evolution. But we had to look outside of Olorgesailie to many other early human sites to really test the idea. What we have found is that the most prolonged periods of climate variability early on corresponded with the origin of stone tools and of eating meat, and the origin of our own genus, *Homo*. Then, later on, another prolonged period of climate variability, very dramatic, corresponded with the origin of modern human behavior and our own species.

So it really does look, on the grand scale, as if these pulses of climate variability were the engine that was powering human evolution?

When you think about it, we started out as a tropical African ape-like population and species, and after a period of diversification of our family tree—and extinction, real survival challenges—we now end up with one species, our own, spread all over the world. That's a story of adaptability. And so the question that we've posed is, How does adaptability evolve? It seems like it would evolve in relation to vast and dramatic climate changes.

**NATURAL SELECTION AT WORK**

But survival works on the basis of the individual. How could a quality like adaptability, which would only become evident over hundreds or thousands of years and many generations, be selected for?

Generally, the idea of natural selection involves the reproductive success and survival of individuals. But when we're looking at evolution by natural selection, you have to take into account the success of individuals not only living at the same time in one generation but over many generations. And what the environmental sciences have contributed is that the environment changes. The rules of the survival game are upturned every once in a while, and the descendants of a single lineage will experience many different environments over time. So the idea of variability driving evolution is the idea that adaptability will evolve in relation to vast periods of environmental change over time.

But despite its success as a species, *Homo erectus* ultimately couldn't adapt.

Right. What we see in this record of vast environmental change here is that *Homo erectus* and the handaxe makers had a very enduring and adaptable way of life, but ultimately they became extinct. And it brings up the question: Why did their way of life dissolve? Well, we have our own species now, highly adaptable, spread all over the world. It seems like we might persist forever. But evolution brings up this point of: What tips the balance between persistence, adaptability, and success, as in *Homo erectus* and our own species, but then extinction?

*I like to think of them as the lawnmowers of the Pleistocene.*

And *Homo erectus* was around an awful lot longer than we've been. People think that we, *Homo sapiens*, are this great thing.

Yes. The handaxe makers here at Olorgesailie and at other sites in East Africa, and the species *Homo erectus*, were around for about 1.5 million years—a vast period of time. Our own species has only been around for about 200,000 years, as far as we know—just a blip of evolutionary time. So, yes, we see ourselves as successful, spread all around the world, and sort of at the top of the heap. But we have not yet proven whether we can be as successful even as *Homo erectus*.

So the jury is still out on *sapiens*. 
That's right. The jury is still out on sapiens.

The landscape around Olorgesailie today looks very different than it did when Homo erectus was crafting handaxes here over 500,000 years ago. Enlarge

Photo credit: © Jason F. Nichols

SITE OF CHANGE

You know this landscape here so well. If we could see a million years of history of Olorgesailie speeded up and watch it in five minutes, what are some of the changes we would see in this environment?

The starting point of the environmental history of this region was a volcanic plain. It was probably a very forbidding place, but as the volcanic landscape cooled, there were earthquakes and then sort of pockets in which rainwater could accumulate, and that was the beginning of the lake. And the lake spread over time. We see the glaring white sediments of the lake expanding and then contracting. There were periods of drought. This was interrupted by periods of volcanic eruption, times when pumice and ash would rain down on the landscape, sometimes killing off all the grass. The animals would need to move away. The handaxe makers kept coming back, though, through all these different layers.

Sometimes stream channels and rivers would come through the area, and the lake would come back again. Over and over again these enormous changes [occurred] in the water resources and the food that early humans and other animals needed to survive. We then see about 500,000 years ago that earthquakes lifted up this entire region, and the lake completely drained away. That led to a landscape that was cut into vast valleys and then filled up again with sediment, depending upon whether it was dry or wet.

The last event we see here recorded in the sediments was about 60,000 years ago, when it was a probably very wet time. Due to earthquake activity maybe 100 miles to the north, an enormous amount of water rushed through and boulders were driven into this area. An awful time to live here. Then, as you can see, the valley was cut again, and it's an incredibly dry place today. So, despite these dry, dusty sediments that we dig, this was once a well-watered place, but a place of immense environmental change.

Lots of other animals survived these changes along with our human ancestors. What distinguishes those species that survived from those that didn't?

Well, it's interesting that as we have excavated through these different layers, we have found evidence of large elephants and enormous pigs, and baboons and zebra and hippopotamuses, all of which were specialized in their chewing apparatus—their teeth and the muscles that move their jaws—toward eating grass. I like to think of them as the lawnmowers of the Pleistocene. They ate grass, and they ate it in abundance. But as we see evidence of an increase in environmental variability through time, we see, as I mentioned, that those animals go extinct. The savanna animals were not the ones that survived.

Rather it's their cousins, such as the baboons today that can eat tree leaves as well as grass and dig for underground resources with their hands, or elephants who can live anywhere from deserts to forested environments, who are the real survivors in Africa today. And we're part of the picture, too. The handaxe makers may have been part of the fauna that was adapted to environmental changes, but mainly in open kinds of habitats. But when environmental variability increased even more, their way of life went away, and a more adaptable, more flexible way of life, represented ultimately by our own species, evolved.

Elephants in Africa today are generalists that, like modern humans, are able to live in a variety of environments. Enlarge

Photo credit: © Graeme Purdy/istockphoto
Does evolution always favor generalists?

Evolution favors both generalists and those species well adapted to specific habitats—as long as those species can move. When we see these environmental changes, wet and dry, we see that the favored ranges, the favored habitats of particular animals, sometimes become smaller, or they expand, or they move to the south or north. It’s critical for animals that are adapted to specific environments to be able to track those habitats. In some ways, they can stabilize the conditions of natural selection. Without the ability to move, as when there are fences or highways or cities, they’re in a lot of trouble in the long-term.

ROOTS OF SYMBOLISM

You’ve found pigments at this site. Is it true that these are the very first pigments ever found?

Yeah, these are the earliest known pigments, at least in an archeological setting that is well dated. We have a volcanic ash that is represented in the pile of sediments here dated to 340,000 years ago, and this is below that, so it’s older in age.

What might the early humans here have used these pigments for? What did they signify?

We don’t know exactly what these pigments would have been used for. But they could represent the first really clear symbolic objects, in terms of people marking objects, marking themselves, creating a sense of group identity. What symbolism means is that you have the ability to recall the past in a better way, to plan for the unexpected, and also to imagine the future.

There were tremendous survival advantages in being able to create a symbolic world that people in another place could understand. You could begin to have shared beliefs, shared values. And even something as simple as the exchange of valued raw material that could be made into sharp hunting objects over tens or hundreds of miles meant that these people had a unity, a group unity, which really is the beginning of a modern human way of life. We all create for ourselves a symbolic universe. We live in a symbolic world, and these could be the rudiments of just that world.

Our own species has evolved an ability to diversify our options.

Do you think the innovation of symbolism gave our ancestors an adapted survival advantage in times of environmental change?

During times of climate instability, such as the time when we see these innovations, just think of what would happen if the food in your environment or the water dried up. You couldn't find food, you couldn't find water. Well, having a symbolic connection with people a hundred miles away, having an exchange network with that group so far away, meant that you could have, in a sense, an insurance policy against the survival challenges in your own place. You could rely upon sharing the survival resources available in another place.

When we think about our own lives and the ways in which we depend upon people, whether it's global aid to help people in times of catastrophe or even our own insurance policies, we're really seeing the beginning of that way of thinking right in these little objects 350,000 years ago.

The human family tree bristles with dead branches—early hominids that, despite surviving for more than a million years in cases like *Homo erectus*, ultimately died out. For a look at our family tree, see Who's Who in Human Evolution. Enlarge

Photo credit: © WGBH Educational Foundation

EXTINCTION AMONG OUR KIND

When you look back to these periods of high variability, do you envisage large die-offs among hominid species? Does evolution happen faster when populations are reduced to tiny pockets?

The human family tree is full of experiments in being human—twigs and branches on the tree. It’s as full as the evolutionary histories of other organisms, but there’s only one surviving human now, and that’s us. Our family tree is full of dead branches.

And what we see in the lives of the earlier humans is that they lived in small populations, sometimes isolated from one another. In some ways, even on vast continents like Africa, they may have lived on what would have been almost little continental islands, habitats that they favored in particular. But that’s a situation where in the long-term there’s going to be a lot of origination of species and extinction. That seems to characterize our own family tree.

So when you look at human evolution in the context of the dramatic environmental changes on Earth, and even in particular
regions like East Africa, you can see the reasons why there would be a number of experiments in being human—*Homo erectus*, *Homo heidelbergensis*, Neanderthals, and so on. And you can see also why they persisted for a long period of time and then became extinct.

In that respect, there's nothing special about humans. That's true of any animal species.

Well, one thing that's part of the adaptability our own species has evolved is an ability to diversify our options. We have different cultures. We're characterized by cultural diversity in a way that no previous early human had been. One wonders whether this may be our ultimate card to success, as long as we can keep those options open. Neanderthals were the Ice Age specialists. *Homo erectus*, while spread over a wide area, had essentially one way of life, and ultimately their way of life became extinct. Human beings today are all over the place in terms of the many diverse ways we live, and so perhaps that will be the most important thing with regard to the success of the only remaining human species today.

---

Interview conducted August 9–11, 2008 by Graham Townsley, producer of "Becoming Human," and edited by Peter Tyson, editor in chief of NOVA Online