Letter from the Desk of David Challinor
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This month's letter concerns "knappers and knapping" and the saga of "Ginsberg," a 23-year-old female African elephant at the Franklin Park Zoo in Boston who died an untimely death in February 1978. This elephant died unexpectedly of a blood clot just before the famous snow storm that for the first time closed down all the campuses around Boston. The storm's fortuitous timing becomes evident later in the story. Ginsberg has been enshrined in the popular and scientific literature (*National Geographic,* July 1978, *Smithsonian Magazine,* July 1978 and *Science*: Vol. 312, 24 Apr. 1981) because of experiments conducted on her carcass.

To return to Ginsberg's death; as we at the National Zoo well know, it is a major project to necropsy and dispose of the carcasses of megafauna. Therefore, the Franklin Park Zoo called Harvard's Museum of Comparative Zoology (MCZ) to see if anyone there might be interested in a dead elephant. As luck would have it, a young graduate student was studying the extensive nerve morphology of the trunk. An earlier XIX century description was inaccurate, out-of-date and badly in need of revision. The MCZ thus called the Zoo to express its willingness to accept only the head. But the Zoo insisted on a "package deal" and after considerable negotiation, Ginsberg was trucked to Harvard, MA (just west of Cambridge) where the University had a rural observatory surrounded by forest. When the roads were plowed, Ginsberg's body was deposited in a large snow bank at the observatory and her head went to MCZ for dissection.

Meanwhile, the MCZ contacted the Smithsonian Institution and learned that Dennis Stanford, a Museum of Natural History archeologist, was anxious to acquire the body. He was investigating a putative (assumed) pre-Clovis site in Colorado. (The Clovis culture, named after its characteristic stone tools, existed 11,000 to 11,500 years ago.) Stanford found evidence at his site that some large mammal bones, including those of mammoths, seemed to have been worked on by humans. To test the hypothesis that green (fresh) mammoth bone could be flaked and thus become a sharp cutting tool, Stanford sent the Smithsonian's beached-whale salvage truck to Massachusetts and moved the headless carcass back to the National Zoo's research facility in Front Royal, VA. Fortunately, Front Royal was also snow-covered with temperatures at or below freezing. While the carcass was en route, Stanford and his colleagues, Errett Calahan and Robson Bonnichsen, started making stone blades to use in butchering the elephant.

It was from this activity that I first learned of the great 1970's revival of flintknapping. It had never occurred to me that people today could master this truly ancient technique and yet, it all made perfect sense. Archeologists studying early human tool users clearly needed to understand how these Stone Age artisans operated. Both academic and lay flintknappers became so skillful that they could emulate the products of flintknappers living 30,000 to 40,000 years ago. In fact, a few unscrupulous individuals sold their blades and arrowheads to unwitting buyers as genuine Neolithic artifacts.

Back to Ginsberg's carcass; it now lay in an unheated barn at Front Royal, ready for the experiments to be completed before the weather warmed enough to ripen her remains. Among the trials was one to determine the effectiveness of atlatls (throwing sticks) as a means of killing a mammoth. An atlatl (an Aztec word) is a wooden rod about 18 to 20 inches-long with a handle at one end and a notch or hook at the other to house the base of the spear. The rod, in effect, extends the length of the thrower's arm, enabling the hunter to hurl his spear farther and with more force than with merely his arm. We learned from this experiment that this technique could indeed penetrate the hard inch-thick skin of an African elephant from a distance of about 20 feet. By extrapolation, it could also work on a mammoth or mastodon mired in a bog or snow drift.

Another investigation determined whether Paleolithic hunters could have used green mammoth bone to make cutting tools to butcher their quarry. Old mammoth bones when dried out are brittle and will not flake. Green (fresh) bone has quite different characteristics and Stanford, a skilled flintknapper, struck off a series of sharp bone flakes from Ginsberg's green humerus (the bone between the shoulder and the elbow), which he and his colleagues used to cut meat from the carcass. The bone flakes, however, could not cut through the thick hide, but were perfectly adequate for cutting muscle tissue. They failed to keep their edge as well as stone tools but were so easy to make that blunt used ones were merely discarded. This experiment explained the assemblages of worn bone flakes found at two Pleistocene butchering sites in the Yukon and Colorado. These two important digs provide the strongest evidence yet of human arrival in the New World at least 50,000 years ago. Many paleoanthropologists challenge this early date because of a lack of human remains, but having made cutting tools from bone flakes, researchers can now distinguish the characteristics of bone flakes struck by humans and those altered by natural causes such as being chewed on by scavengers. Thus, they may in time be able to pinpoint the date of human arrival in the New World.

Other important experiments followed, including a fascinating one that studied how long the haft of a cutting tool had to be in order to skin an elephant or a mammoth. At the very early sites investigated thus far, only stone and bone artifacts have been found. Wooden handles and sinews that bound them to the blades disintegrated relatively rapidly. Using flint blades knapped by Stanford's colleagues Robson Bonnichsen and Errett Calahan, both world-class academic flintknappers, and glued for convenience to hafts of varying length, scientists sought to measure the force it took to cut through the hide. Thanks to help from the Johns Hopkins Applied Physics Laboratory, the bladed hafts were connected to a potentiometer that measured the force necessary to penetrate the tough hide. By extrapolation, the scientists could thereby gain a fairly accurate idea of how long the hafts had to be.

With increasing experience in contemporary flintknapping, archeologists have learned better how to distinguish man-made stone tools from chipped stones that might have resulted from natural causes. Evidence continues to accumulate of just how long ago species of *Homo* have been using stone tools. Another Smithsonian scientist, Richard Potts at the Museum of Natural History, was co-leader of an expedition to China; at a site, Majuangou, about 100 miles west of Beijing, he and his colleagues found stone tools dated at 1.66 million years old. Coupled with a discovery of even older stone tools (1.75 million years ago) unearthed near the Black Sea in the Republic of Georgia, the two finds give strong evidence of the relatively rapid emigration of *Homo erectus* from Africa into Asia. Despite being 100,000 years newer than those found in Georgia, the Chinese tools themselves showed little or no improvement. Although no hominid fossils were discovered at the Chinese site, the bones of deer and other large mammals were scattered among the tools, indicating that the chipped stones and modified bones had been used to butcher the prey. Although hominid fossils were found at the Georgian site, with luck some might also turn up at the Chinese butchering sites to confirm unequivocally the hominid source of the stone tools found there. Pending such a discovery, however, some will remain skeptical of such early tool use. For me, the evidence is strong.

In closing, I encourage those readers who are curious to learn about the science and art of flintknapping to read John C. Whittaker's "Flintknapping-making and understanding stone tools," University of Texas Press, 1994. By following his clearly illustrated directions, you, too, could create the tools used by your forebears a million years ago. Such a connection with a "human" activity of so long ago must indeed be the ultimate in long-term bonding.

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