Letter From the Desk of David Challinor
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Until 10 or 12 thousand years ago, mammoths were relatively common throughout Europe and North America. They were clearly an important feature of the local fauna as evidenced from their widespread depictions on cave walls and bones by our ancestors, who must have been familiar with them. Today it is hard to visualize these giant pachyderms grazing and browsing from the northern steppes of Europe to the Mediterranean coast, the Levant, and east to China. In the new world there were two species: one in the north and the other living as far south as Mexico and from Florida to California. This letter will discuss mammoths: where they originated, how they spread across the northern hemisphere, their inaction with humans, and the role humans may have played in their demise. Mammoths and numerous other large fauna disappeared quite suddenly at the end of the Ice Age in both the old and new worlds.

Fossil evidence indicates that the mammoths' ancestors and the two existing elephant species originated in Africa about five million years ago. The first branch of elephants, Loxodonta, stayed in Africa and is still there today. The second branch, Elaphas, gave rise to the Asian elephant, although at one time other Elaphas species also lived in Africa. A third group of now extinct elephants led to the mammoths, which probably were more closely related to African than to Asian elephants; these definitely were not the progenitors of today's elephants. All three elephant genera lived contemporaneously for about four million years.

About three million years ago mammoths migrated from Africa to Europe through two possible paths: across the western end of the Mediterranean when the Straits of Gibraltar closed and the Mediterranean began to dry up (see Letter From the Desk of...October 1991) or perhaps more likely around the eastern end of the Mediterranean. Bones and teeth from these ancient elephants have turned up in Italy, France, England (then attached to Europe) and east to Russia. The ancestral mammoth (Mammathus meridionalis) was about half again as large as the present African elephant and its tusks were twisted in the characteristic mammoth fashion. It was a browser and fed on leaves and small branches of oak, beech and other familiar European trees. This huge European elephant probably did not have a woolly coat as the climate then was considerably warmer than at present. M. meridionalis survived for about two million years until the climate became colder. It was replaced by a more cold-tolerant species, the steppe mammoth (M. trogontherii), which lasted until about 75,000 years ago. Then the smaller woolly mammoth (M. primigenius), which had first appeared about 250,000 years ago, became the dominant European elephant until its own extinction at the end of the Ice Age. Woolly mammoths at their peak ranged from what is now Great Britain across Eurasia to northeast Siberia, from where they crossed the land bridge to Alaska.

The Columbian mammoth, almost twice the size of the woolly one, inhabited North America south of the woolly's range. The Columbian evolved from the ancestral mammoth that first moved into Europe from Africa and reached the new world about 1.5 million years ago. This giant lived across North America and as far south as Mexico, but was not as adapted to the tundra as its woolly relative. Nonetheless, fossils from both species have been found together, although it is not clear whether both species existed at the same time. Short warming periods may have allowed Columbian mammoths to move north into what had been woolly territory, but the woollies may have gone further north as well.

It is difficult today to imagine how plentiful these pachyderms must have been at their peak. For example, the remains of numerous dwellings framed with mammoth bones have been found in Europe, especially along the Ukraine's Dnieper River. Some of these huts were more than 20 feet in diameter and bones from scores of mammoths were used for each lodging. It is unlikely that these bones came from animals killed by humans. A more likely source would be piles of bones accumulated by river floods. Radiocarbon dating indicates that the bones from one hut spanned a range from 22,000 to 14,000 years ago. People then not only used mammoth bones for construction, but also as fuel where wood was scarce. Surprisingly, bone burns well when it is relatively fresh and still retains fat. Initial combustion is smoky and smelly, but when the fat burns off, bone produces a steady hot flame. Readers may recall the spectacular bonfire of elephant tusks that Richard Leakey ignited to publicize the fight against elephant poaching a few years ago.

Scientists know much about mammoths because they were so plentiful and those that died in the far north did not rot in the frozen subsoil of the tundra. Indeed, the remains are so well preserved that not only the soft internal organs are unspoiled, but even plant material in their stomachs can be identified. By combining preserved mammoth remains with illustrations on cave walls and with what we know of the physiology and behavior of the two surviving elephant species, scientists have constructed a natural history of mammoths that is arguably more detailed than that available for many contemporary mammals.

The genus Mammuthus was clearly a member of the elephant family. It was distinguished from the two surviving elephant species by its woolly coat–an adaptation to a cold environment–and its small ears. Mammoths did not need the large, vein-filled ears of the African elephant to keep cool. The trunk tip differed in having two fingers, each of which was proportionately longer than the African's. A single pronounced dome on the top of the head was also characteristic of mammoths, and when combined with the enormous tusks of the males, separated them from the surviving genera. Mammoth tusks still turn up in Alaska and Siberia, and because they are extinct, their ivory can be bought and sold. The record woolly mammoth tusk found in Siberia measured 13'7'along the curve and weighed 185 pounds. The skull from a Columbian mammoth found in Texas had a tusk 16 feet long; it is now at the American Museum of Natural History in New York City.

Early in the nineteenth century mammoth ivory was a major business in Yakutsk on Siberia's Lena River–18 tons were sold annually. Craftsmen used it for billiard balls, piano keys, as well as beads and figurines. Siberians claim there are hundreds of thousands of mammoth remains still buried in the tundra, more than enough to satisfy the current demand for ivory that is threatening the existence of some contemporary elephant populations. In fact the famous 200-year-old ivory-carving industry in Erbach, Germany imported more than a ton of mammoth ivory from Siberia in 1990 after their stock of legal elephant ivory was depleted.

Mammoth ivory can generally be distinguished from that of elephants as the former is seldom pure white, but more cream-colored or even pale brown. Some carvers feel mammoth ivory has a coarser texture; in cross-section it often shows a crisscross pattern not normally present in elephant tusks. The substitution of mammoth ivory for that from elephants has raised the price of the sub-fossil tusks and has resulted in Siberian "mammoth hunters" taking only ivory from recent mammoth finds. Sadly, the rest of the skeleton is often abandoned and lost to science. Another new problem is that customs officers trying to control current ivory trade need a simple identification test for mammoth ivory; presently they have to depend on radiocarbon dating to be certain.

Although our ancestors hunted mammoths and made figurines, beads and tools from their tusks (both males and females had them), it is unlikely that human hunting was a significant cause for their extinction. For example, there was still a population of small mammoths on Wrangell Island off the northeast Siberian coast only 3500 years ago, at the time the pyramids were being built in Egypt. Since they were not wiped out by human hunters in what is known as the "Pleistocene overkill" about 10,000 years ago, what extirpated them?

At the end of the last Ice Age (10-12,000 years ago), the climate warmed considerably and the grassy steppes occupied by the mammoths converted rapidly to forests. Although African elephants can help maintain their savanna habitat by knocking down trees, an easy feat for mammoths as well, perhaps the forest advance was too fast for them to control. With both food and habitat shrinking, only small pockets of mammoths survived, such as the dwarf ones on Wrangell Island. An enterprising Russian ecologist, Sergei Zimov, has plans to create a "Pleistocene Park" in the tundra of northeastern Siberia above the Arctic circle. He believes he can replace the lichens and mosses growing there with the grass that once covered the area in the Pleistocene. He thinks he can do this by introducing hoofed stock which would tear up the fragile mosses with their hooves and allow grass to take over. He has already fenced a 24 km^2 area (<10 mi^2) and introduced 32 feral local horses to start the process. Later he plans to release musk oxen and Woods bison from Canada. Several American scientists are working with him and although there are many pitfalls to this seemingly far-out experiment, it just may work. It will take at least a decade to get scientific results.

Even if a habitat such as the mammoth steppe can be recreated, it will not pinpoint definitively the cause for mammoth extinction. The earth can warm much faster (measured in decades) than it can cool (centuries to millennia), and the preponderance of evidence for mammoth extinction is climate change, not hunting. Our ancestors had no need to expend energy building pit traps for mammoths when so many other large mammals were easier to hunt and trap. Furthermore, the evidence is sparse that there were enough hunters 10,000 years ago to kill off this huge population that grazed on the mammoth steppes. Evidently the mild, wetter climate caused the taiga forests of the north to invade the grassy steppes. Even further north, melting ice and increasing snow cover slowed plant growth and created the tundra we see today, where reindeer and musk oxen have adapted to feed on the low vegetation that grows in these harsh conditions. Browsers such as moose and woodland caribou are now the dominant megafauna of the taiga forests.

One argument against the climate theory of extinction is that there were at least 20 warming periods in the Pleistocene (last million years), but these intervals never caused extinctions like the last one. Considerably more research will have to be done to explain the apparent anomaly. Scientists can only speculate that the vegetation changes at the end of the last glaciation were somehow different from those of previous glacial cycles. The degree of difference and resulting ecological consequences remain a mystery, but each succeeding generation of investigators builds on what has been learned by his/her predecessors. In time, I am confident we will solve the puzzle.

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P.S. A good recent book on the subject of this letter is Mammoths by Adrian Lister and Paul Bahn, MacMillan, USA 1994.

The article on recreating the Siberian mammoth steppe is in SCIENCE, 282:31-34, 2 October 1998.