

MATTER

A New Company With a Wild Mission: Bring Back the Woolly Mammoth

With \$15 million in private funding, Colossal aims to bring thousands of woolly mammoths back to Siberia. Some scientists are deeply skeptical that will happen.



By Carl Zimmer

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A team of scientists and entrepreneurs announced on Monday that they have started a new company to genetically resurrect the woolly mammoth.

The company, named Colossal, aims to place thousands of these magnificent beasts back on the Siberian tundra, thousands of years after they went extinct.

“This is a major milestone for us,” said George Church, a biologist at Harvard Medical School, who for eight years has been leading a small team of moonlighting researchers developing the tools for reviving mammoths. “It’s going to make all the difference in the world.”

The company, which has received \$15 million in initial funding, will support research in Dr. Church’s lab and carry out experiments in labs of their own in Boston and Dallas.

A former researcher in Dr. Church's lab, Eriona Hysolli, will oversee the new company's efforts to edit elephant DNA, adding genes for mammoth traits like dense hair and thick fat for withstanding cold. The researchers hope to produce embryos of these mammoth-like elephants in a few years, and ultimately produce entire populations of the animals.

Other researchers are deeply skeptical that Colossal will pull off such a feat. And if Colossal does manage to produce baby mammoth-like elephants, the company will face serious ethical questions. Is it humane to produce an animal whose biology we know so little about? Who gets to decide whether they can be set loose, potentially to change the ecosystems of tundras in profound ways?

An illustration of a woolly mammoth, a species that lived in the Arctic and died out at the end of the Pleistocene. Warren Photographic / Science Source

“There’s tons of trouble everyone is going to encounter along the way,” said Beth Shapiro, a paleogeneticist at the University of California Santa Cruz and the author of “How to Clone a Mammoth.”

The idea behind Colossal first emerged into public view in 2013, when Dr. Church sketched it out in a talk at the National Geographic Society.

At the time, researchers were learning how to reconstruct the genomes of extinct species based on fragments of DNA retrieved from fossils. It became possible to pinpoint the genetic differences that set ancient species apart from their modern cousins, and to begin to figure out how those differences in DNA produced differences in their bodies.

Dr. Church, who is best known for inventing ways of reading and editing DNA, wondered if he could effectively revive an extinct species by rewriting the genes of a living relative. Because Asian elephants and mammoths share a common ancestor that lived about six million years ago, Dr. Church thought it might be possible to modify the genome of an elephant to produce something that would look and act like a mammoth.

Beyond scientific curiosity, he argued, revived woolly mammoths could help the environment. Today, the tundra of Siberia and North America where the animals once grazed is rapidly warming and releasing carbon dioxide. “Mammoths are hypothetically a solution to this,” Dr. Church argued in his talk.

Today the tundra is dominated by moss. But when woolly mammoths were around, it was largely grassland. Some researchers have argued that woolly mammoths were ecosystem engineers, maintaining the grasslands by breaking up moss, knocking down trees and providing fertilizer with their droppings.

Russian ecologists have imported bison and other living species to a preserve in Siberia they’ve dubbed Pleistocene Park, in the hopes of turning the tundra back to grassland. Dr. Church argued that resurrected woolly mammoths

would be able to do this more efficiently. The restored grassland would keep the soil from melting and eroding, he argued, and might even lock away heat-trapping carbon dioxide.

Dr. Church's proposal attracted a lot of attention from the press but little funding beyond \$100,000 from PayPal co-founder Peter Thiel. Dr. Church's lab piggybacked mammoth research on to other, better-funded experiments.

"This set of tools can be used for many purposes, whether it's de-extinction or recoding the human genome," Dr. Hysolli said.

Eriona Hysolli sampling a woolly
mammoth leg.
George Church

Analyzing the genomes of woolly mammoths collected from fossils, Dr. Hysolli and her colleagues drew up a list of the most important differences between the animals and elephants. They zeroed in on 60 genes that their experiments suggest are important to the distinctive traits of mammoths, such as hair, fat and the woolly mammoth's distinctively high-domed skull.

“Frankly, I was planning on slogging along at a slow pace,” Dr. Church said. But in 2019, he was contacted by Ben Lamm, the founder of the Texas-based artificial intelligence company Hypergiant, who was intrigued by press reports of the de-extinction idea.

Mr. Lamm visited Dr. Church's lab, and the two hit it off. “After about a day of being in the lab and spending a lot of time with George, we were pretty passionate on pursuing this,” Mr. Lamm said.

Mr. Lamm began setting up Colossal to support Dr. Church's work, all the way from tinkering with DNA to eventually placing “a functional mammoth,” as Dr. Hysolli calls it, in the wild.

The company's initial funding comes from investors ranging from Climate Capital, a private equity firm that backs efforts to lower carbon emissions, to the Winklevoss twins, known for their battles over Facebook and investments in Bitcoin.

The scientists will try to make an elephant embryo with its genome modified to resemble an ancient mammoth. To do this, the scientists will need to remove DNA from an elephant egg and replace it with the mammoth-like DNA.

But no one has ever harvested eggs from an elephant. In case it doesn't work, Dr. Hysolli and her colleagues will also investigate turning ordinary elephant tissue into stem cells, which could possibly then be coaxed to develop into embryos in the lab.

A section of stained mammoth bone.
Ben Lamm

Initially, Dr. Church envisioned implanting embryos into surrogate female elephants. But he eventually soured on the idea. Even if he could figure out in vitro fertilization for elephants — which no one has done before — building a herd would be impractical, since he would need so many surrogates.

Instead, Dr. Church decided to make an artificial mammoth uterus lined with uterine tissue grown from stem cells. “I’m not making a bold prediction this is going to be easy,” he said. “But everything up to this point has been relatively easy. Every tissue we’ve gone after, we’ve been able to get a recipe for.”

The idea has a few precedents. At the Children’s Hospital of Philadelphia, researchers have developed a sealed bag that can support a fetal lamb for four weeks, for example. But Colossal will need to build an artificial uterus big enough to house a fetus for around two years, reaching a weight of 200 pounds.

Heather Browning, a philosopher at the London School of Economics, said that whatever benefits mammoths might have to the tundra will need to be weighed against the possible suffering that they might experience in being brought into existence by scientists.

“You don’t have a mother for a species that — if they are anything like elephants — has extraordinarily strong mother-infant bonds that last for a very long time,” she said. “Once there is a little mammoth or two on the ground, who is making sure that they’re being looked after?”

And Colossal's investors may have questions of their own: How will these mammoths make any money? Mr. Lamm predicted that the company would be able to spin off new forms of genetic engineering and reproductive technology.

Ben Lamm and George Church. Colossal

“We are hopeful and confident that there will be technologies that come out of it that we can build individual business units out of,” Mr. Lamm said. “But in the short term, our focus is really just making those technologies that we know will speed up the process and the efficiency of not just bringing back the mammoth, but in the rewilding of the mammoth.”

Dr. Shapiro of U.C. Santa Cruz is skeptical about the company's prospects. “It feels to me that a mammoth is a long way in the future,” she said. Nevertheless, she applauded the company's launch and hopes it will deliver scientific advances that could help species that are endangered but not yet extinct.

For example, scientists may be able to use Colossal's advances to save species under threat from diseases by endowing them with genes for resistance to a pathogen, she said. Other species might be enriched with genes to better tolerate heat and drought brought on by climate change.

“I worry that for lots of species today, the pace of climate change and the pace of habitat degradation is such that evolution isn’t going to be able to save them,” Dr. Shapiro said. “We need to intervene even more.”