

Welcome to Pleistocene Park



Story by Ross Andersen

NIKITA ZIMOV'S NICKNAME for the vehicle seemed odd at first. It didn't look like a baby mammoth¹. It looked like a small tank, with armored wheels and a pit bull's center of gravity. Only after he smashed us into the first tree did the connection become clear. (1)

We were driving through a remote forest in Eastern Siberia², just north of the Arctic Circle³, when it happened. The summer thaw was in full swing. The undergrowth glowed green, and the air hung heavy with mosquitoes. We had just splashed through a series of deep ponds

¹ mammoth: noun: a large extinct elephant of the Pleistocene epoch, typically hairy with a sloping back and long curved tusks

² Siberia: noun: a vast region of Russia that extends from the Ural Mountains to the Pacific Ocean and from the Arctic coast to the northern borders of Kazakhstan, Mongolia, and China. Noted for the severity of its winters, it was traditionally used as a place of exile; it is now a major source of minerals and hydroelectric power.

³ Arctic Circle: noun: the parallel of latitude 66° 33' north of the equator. It marks the northernmost point at which the sun is visible on the northern winter solstice and the southernmost point at which the midnight sun can be seen on the northern summer solstice

when, without a word of warning, Nikita veered off the trail and into the trees, ramming us into the trunk of a young 20-foot larch⁴. The wheels spun for a moment, and then surged us forward. A dry crack rang out from under the fender as the larch snapped cleanly at its base and toppled over, falling in the quiet, dignified way that trees do. (2)

I had never seen Nikita happier. Even seated behind the wheel, he loomed tall and broad-shouldered, his brown hair cut short like a soldier's. He fixed his large ice-blue eyes on the fallen tree and grinned. I remember thinking that in another age, Nikita might have led a hunter-gatherer band in some wildland of the far north. He squeezed the accelerator, slamming us into another larch, until it too snapped and toppled over, felled by our elephantine force. We rampaged 20 yards with this same violent rhythm—churning wheels, cracking timber, silent fall—before stopping to survey the flattened strip of larches in our wake. (3)

“In general, I like trees,” Nikita said. “But here, they are against our theory.” (4)

Behind us, through the fresh gap in the forest, our destination shone in the July sun. Beyond the broken trunks and a few dark tree-lined hills stood Pleistocene⁵ Park, a 50-square-mile nature reserve of grassy plains roamed by bison, musk oxen, wild horses, and maybe, in the not-too-distant future, lab-grown woolly mammoths. Though its name winks at *Jurassic Park*, Nikita, the reserve's director, was keen to explain that it is not a tourist attraction, or even a species-resurrection project. It is, instead, a radical geoengineering⁶ scheme. (5)

“It will be cute to have mammoths running around here,” he told me. “But I'm not doing this for them, or for any other animals. I'm not one of these crazy scientists that just wants to make the world green. I am trying to solve the larger problem of climate change. I'm doing this for humans. I've got three daughters. I'm doing it for them.” (6)

Pleistocene Park is named for the geological epoch⁷ that ended only 12,000 years ago, having begun 2.6 million years earlier. Though colloquially known as the Ice Age, the Pleistocene

⁴ larch: noun: a coniferous tree with bunches of deciduous bright green needles, found in cool regions of the northern hemisphere. It is grown for its tough timber and its resin (which yields turpentine)

⁵ Pleistocene: adjective: relating to or denoting the first epoch of the Quaternary period between the Pliocene and Holocene epochs: *at the end of the Pleistocene era sea levels increased*. Pleistocene: noun: (the Pleistocene) the first epoch of the Quaternary period, between the Pliocene and the Holocene epochs, or the system of deposits laid down during it: *the glacial world of the Pleistocene was dramatically different from our own*. The Pleistocene epoch lasted from 2,640,000 to about 10,000 years ago. It was marked by great fluctuations in temperature that caused the ice ages, with glacial periods followed by warmer interglacial periods. Several forms of fossil human, leading up to modern humans, appeared during this epoch.

⁶ geoengineering: noun: the deliberate large-scale manipulation of an environmental process that affects the earth's climate, in an attempt to counteract the effects of global warming

⁷ geology: noun: the science that deals with the earth's physical structure and substance, its history, and the processes that act on it | geological: adjective: relating to geology: the geological features of an area: *the geology of the Outer Hebrides* | the geological features of a planetary body: *the geology of the surface of Mars*

epoch: noun: *Geology*: a division of time that is a subdivision of a period and is itself subdivided into ages, corresponding to a series in chronostratigraphy: *the Pliocene epoch*

could easily be called the Grass Age. Even during its deepest chills, when thick, blue-veined glaciers were bearing down on the Mediterranean, huge swaths of the planet were coated in grasslands. In Beringia, the Arctic belt that stretches across Siberia, all of Alaska, and much of Canada's Yukon, these vast plains of green and gold gave rise to a new biome⁸, a cold-weather version of the African savanna⁹ called the Mammoth Steppe¹⁰. But when the Ice Age ended, many of the grasslands vanished under mysterious circumstances, along with most of the giant species with whom we once shared this Earth. (7)

Nikita is trying to resurface Beringia with grasslands. He wants to summon the Mammoth Steppe ecosystem, complete with its extinct creatures, back from the underworld of geological layers. The park was founded in 1996, and already it has broken out of its original fences, eating its way into the surrounding tundra¹¹ scrublands and small forests. If Nikita has his way, Pleistocene Park will spread across Arctic Siberia and into North America, helping to slow the thawing of the Arctic permafrost¹². Were that frozen underground layer to warm too quickly, it would release some of the world's most dangerous climate-change accelerants¹³ into the atmosphere, visiting catastrophe on human beings and millions of other species. (8)

In its scope and radicalism, the idea has few peers, save perhaps the scheme to cool the Earth by seeding the atmosphere with silvery mists of sun-reflecting aerosols¹⁴. Only in Siberia's empty expanse could an experiment of this scale succeed, and only if human beings learn to cooperate across centuries. This intergenerational work has already begun. It was Nikita's father, Sergey, who first developed the idea for Pleistocene Park, before ceding control of it to Nikita. (9)

The Zimovs have a complicated relationship. The father says he had to woo¹⁵ the son back to the Arctic. When Nikita was young, Sergey was, by his own admission, obsessed with work. "I don't think he even paid attention to me until I was 20," Nikita told me. Nikita went away for high school, to a prestigious science academy in Novosibirsk, Siberia's largest city. He found life there to his liking, and decided to stay for university. Sergey made the journey to

chronostratigraphy: noun: a branch of geology concerned with establishing the absolute ages of strata

strata: noun (plural strata): a layer or series of layers of rock in the ground

⁸ biome: noun (ecology): a large naturally occurring community of flora and fauna occupying a major habitat, e.g. forest or tundra

⁹ savannah: noun: a grassy plain in tropical and subtropical regions, with few trees

¹⁰ steppe: noun: a large area of flat unforested grassland in southeastern Europe or Siberia

¹¹ tundra: noun: a vast, flat, treeless Arctic region of Europe, Asia, and North America in which the subsoil is permanently frozen

¹² permafrost: noun: a thick subsurface layer of soil that remains frozen throughout the year, occurring chiefly in polar regions

¹³ accelerant: noun: accelerating or causing acceleration

¹⁴ aerosol: noun: a substance enclosed under pressure and able to be released as a fine spray, typically by means of a propellant gas

¹⁵ woo: verb: seek the favor, support, or custom of

Novosibirsk during Nikita's freshman year and asked him to come home. It would have been easy for Nikita to say no. He soon started dating the woman he would go on to marry. Saying yes to Sergey meant asking her to live, and raise children, in the ice fields at the top of the world. And then there was his pride. "It is difficult to dedicate your life to someone else's idea," he told me. (10)

But Sergey was persuasive. Like many Russians, he has a poetic way of speaking. In the Arctic research community, he is famous for his ability to think across several scientific disciplines. He will spend years nurturing a big idea before previewing it for the field's luminaries. It will sound crazy at first, several of them told me. "But then you go away and you think," said Max Holmes, the deputy director of Woods Hole Research Center, in Massachusetts. "And the idea starts to make sense, and then you can't come up with a good reason why it's wrong." (11)

Of all the big ideas that have come spilling out of Sergey Zimov, none rouses his passions like Pleistocene Park. He once told me it would be "the largest project in human history." (12)

AS IT HAPPENS, human history began in the Pleistocene. Many behaviors that distinguish us from other species emerged during that 2.6-million-year epoch, when glaciers pulsed down from the North Pole at regular intervals. In the flood myths of Noah and Gilgamesh, and in Plato's story of Atlantis, we get a clue as to what it was like when the last glaciation ended and the ice melted and the seas welled up, swallowing coasts and islands. But human culture has preserved no memory of an *oncoming* glaciation. We can only imagine what it was like to watch millennia of snow pile up into ice slabs that pushed ever southward. In the epic poems that compress generations of experience, a glaciation would have seemed like a tsunami of ice rolling down from the great white north. (13)

One of these 10,000-year winters may have inspired our domestication of fire, that still unequalled technological leap that warmed us, warded away predators¹⁶, and cooked the calorie-dense meals that nourished our growing brains. On our watch, fire evolved quickly, from a bonfire at the center of camp to industrial combustion that powers cities whose glow can be seen from space. But these fossil-fueled fires give off an exhaust, one that is pooling, invisibly, in the thin shell of air around our planet, warming its surface. And nowhere is warming faster, or with greater consequence, than the Arctic. (14)

Every Arctic winter is an Ice Age in miniature. In late September, the sky darkens and the ice sheet atop the North Pole expands, spreading a surface freeze across the seas of the Arctic Ocean, like a cataract¹⁷ dilating over a blue iris. In October, the freeze hits Siberia's north coast and continues into the land, sandwiching the soil between surface snowpack and subterranean¹⁸ frost. When the spring sun comes, it melts the snow, but the frozen underground layer remains. Nearly a mile thick in some places, this Siberian permafrost

¹⁶ predator: noun: an animal that naturally preys on others

¹⁷ cataract: noun: 1) a large waterfall; 2) a medical condition in which the lens of the eye becomes progressively opaque (not able to see through), resulting in blurred vision

¹⁸ subterranean: adjective: existing, occurring, or done under the earth's surface

extends through the northern tundra moonscape and well into the taiga¹⁹ forest that stretches, like an evergreen stripe, across Eurasia's²⁰ midsection. Similar frozen layers lie beneath the surface in Alaska and the Yukon, and all are now beginning to thaw. (15)

If this intercontinental ice block warms too quickly, its thawing will send as much greenhouse gas into the atmosphere each year as do all of America's SUVs, airliners, container ships, factories, and coal-burning plants combined. It could throw the planet's climate into a calamitous²¹ feedback loop²², in which faster heating begets faster melting. The more apocalyptic²³ climate-change scenarios will be in play. Coastal population centers could be swamped. Oceans could become more acidic. A mass extinction could rip its way up from the plankton base of the marine food chain. Megadroughts could expand deserts and send hundreds of millions of refugees across borders, triggering global war. (16)

"Pleistocene Park is meant to slow the thawing of the permafrost," Nikita told me. The park sits in the transition zone between the Siberian tundra and the dense woods of the taiga. For decades, the Zimovs and their animals have stripped away the region's dark trees and shrubs to make way for the return of grasslands. Research suggests that these grasslands will reflect more sunlight than the forests and scrub they replace, causing the Arctic to absorb less heat. In winter, the short grass and animal-trampled snow will offer scant insulation, enabling the season's freeze to reach deeper into the Earth's crust, cooling the frozen soil beneath and locking one of the world's most dangerous carbon-dioxide lodes in a thermodynamic vault²⁴. (17)

To test these landscape-scale cooling effects, Nikita will need to import the large herbivores²⁵ of the Pleistocene. He's already begun bringing them in from far-off lands, two by two, as though filling an ark. But to grow his Ice Age lawn into a biome that stretches across continents, he needs millions more. He needs wild horses, musk oxen, reindeer, bison, and predators to corral the herbivores into herds. And, to keep the trees beaten back, he needs hundreds of thousands of resurrected woolly mammoths. (18)

¹⁹ taiga: noun (often **the taiga**): the sometimes swampy coniferous forest of high northern latitudes, especially that between the tundra and steppes of Siberia and North America

²⁰ Eurasia: noun: a term used to describe the combined continental landmass of Europe and Asia

²¹ calamitous: adjective: disastrous: *such calamitous events as fires, hurricanes, and floods.*

²² feedback loop: noun: Feedback occurs when outputs of a system are routed back as inputs as part of a chain of cause-and-effect that forms a circuit or loop

²³ apocalyptic: adjective: the complete destruction of the world

²⁴ thermodynamic: Thermodynamics is the study of the relations between heat, work, temperature, and energy. The laws of thermodynamics describe how the energy in a system changes and whether the system can perform useful work on its surroundings. Thermodynamics is a branch of physics that studies how energy changes in a system. The key insight of thermodynamics is that heat is a form of energy that corresponds to mechanical work (that is, exerting a force on an object over a distance). vault: noun: a large room or chamber used for storage, especially an underground one. Thermodynamic vault: an underground chamber created by temperature difference between the air and the ground. The ground stores CO² because the ground remains frozen.

²⁵ herbivore: noun: an animal that feeds on plants

Video: The Russian Scientists Bringing Back the Ice Age

<https://vimeo.com/207624364>

In *Mammoth*, a short documentary by Grant Slater, Sergey and Nikita Zimov explain the vision behind Pleistocene Park. (19)

AS A SPECIES, the woolly mammoth is fresh in its grave. People in Siberia still stumble on frozen mammoth remains with flesh and fur intact. Some scientists have held out hope that one of these carcasses may contain an undamaged cell suitable for cloning. But *Jurassic Park* notwithstanding, the DNA of a deceased animal decays quickly. Even if a deep freeze spares a cell the ravenous microbial swarms that follow in death's wake, a few thousand years of cosmic rays²⁶ will reduce its genetic code to a jumble of unreadable fragments. (20)

You could wander the entire Earth and not find a mammoth cell with a perfectly preserved nucleus. But you may not need one. A mammoth is merely a cold-adapted member of the elephant family. Asian elephants in zoos have been caught on camera making snowballs with their trunks. Modify the genomes of elephants like those, as nature modified their ancestors' across hundreds of thousands of years, and you can make your own mammoths. (21)

The geneticist George Church and a team of scientists at his Harvard lab are trying to do exactly that. In early 2014, using CRISPR²⁷, the genome-editing technology, they began flying along the rails of the Asian elephant's double helix, switching in mammoth traits. They are trying to add cold-resistant hemoglobin²⁸ and a full-body layer of insulating fat. They want to shrink the elephant's flapping, expressive ears so they don't freeze in the Arctic wind, and they want to coat the whole animal in luxurious fur. By October 2014, Church and his team had succeeded in editing 15 of the Asian elephant's genes. Late last year he told me he was tweaking 30 more, and he said he might need to change only 50 to do the whole job. (22)

When I asked Beth Shapiro, the world's foremost expert in extinct species' DNA, about Church's work, she gushed. "George Church is awesome," she said. "He's on the right path, and no one has made more progress than him. But it's too early to say whether it will take only 50 genes, because it takes a lot of work to see what each of those changes is going to do to the whole animal." (23)

²⁶ cosmic rays: noun: Cosmic rays are high-energy protons and atomic nuclei which move through space at nearly the speed of light. They originate from the sun, from outside of the solar system, and from distant galaxies

²⁷ CRISPR: acronym: (clustered regularly interspaced short palindromic repeats); noun: a segment of DNA containing short repetitions of base sequences, involved in the defense mechanisms of prokaryotic organisms to viruses; a genetic engineering tool that uses a CRISPR sequence of DNA and its associated protein to edit the base pairs of a gene

²⁸ Hemoglobin: noun: a red protein responsible for transporting oxygen in the blood of vertebrates

Even if it takes hundreds of gene tweaks²⁹, Church won't have to make a perfect mammoth. If he can resculpt the Asian elephant so it can survive Januarys in Siberia, he can leave natural selection to do the polishing. For instance, mammoth hair was as long as 12 inches, but shorter fur will be fine for Church's purposes. Yakutian³⁰ wild horses took less than 1,000 years to regrow long coats after they returned to the Arctic. (24)

"The gene editing is the easy part," Church told me, before I left for Pleistocene Park. Assembling the edited cells into an embryo that survives to term is the real challenge, in part because surrogacy is out of the question. Asian elephants are an endangered species. Few scientists want to tinker with their reproductive processes, and no other animal's womb will do. Instead, the embryos will have to be nurtured in an engineered environment, most likely a tiny sac of uterine³¹ cells at first, and then a closet-size tank where the fetus can grow into a fully formed, 200-pound calf. (25)

No one has yet brought a mammal to term in an artificial environment. The mammalian mother-child bond, with its precisely timed hormone releases, is beyond the reach of current biotechnology³². But scientists are getting closer with mice, whose embryos have now stayed healthy in vitro for almost half of their 20-day gestation period. Church told me he hopes he'll be manufacturing mice in a lab within five years. And though the elephant's 22-month gestation³³ period is the longest of any mammal, Church said he hopes it will be a short hop from manufacturing mice to manufacturing mammoths. (26)

Church has been thinking about making mammoths for some time, but he accelerated his efforts in 2013, after meeting Sergey Zimov at a de-extinction conference in Washington, D.C. Between sessions, Sergey pitched him on his plan to keep Beringia's permafrost frozen by giving it a top coat of Ice Age grassland. When he explained the mammoth's crucial role in that ecosystem, Church felt compelled to help. He told me he hopes to deliver the first woolly mammoth to Pleistocene Park within a decade. (27)

LAST SUMMER, I traveled 72 hours, across 15 time zones, to reach Pleistocene Park. After Moscow, the towns, airports, and planes shrunk with every flight. The last leg

²⁹ tweak: verb: (informal) improve (a mechanism or system) by making fine adjustments to it

³⁰ Yakutia: noun: an autonomous republic in eastern Russia; population 948,400 (est. 2009); capital, Yakutsk. It is the coldest inhabited region in the world, with 40 percent of its territory lying north of the Arctic Circle. Official name Sakha, Republic of. The **Yakutian** or **Yakut** is a native horse breed from the Siberian Sakha Republic (or Yakutia) region. It is large compared to the otherwise similar Mongolian horse and Przewalski's horse. It is noted for its adaptation to the extreme cold climate of Yakutia, including the ability to locate and graze on vegetation that is under deep snow cover,^[3] and to survive without shelter in temperatures that reach -70 °C (-94 °F). The horses appear to have evolved from domesticated horses brought with the Yakuts when they migrated to the area beginning in the 13th century, and are not descended from wild horses known to inhabit the area in Neolithic times.

³¹ uterine: adjective: relating to the uterus or womb

³² biotechnology: noun: the exploitation of biological processes for industrial and other purposes, especially the genetic manipulation of microorganisms for the production of antibiotics, hormones, etc.

³³ gestation: noun: the process of carrying or being carried in the womb between conception and birth

flew out of Yakutsk³⁴, a gray city in Russia's far east, whose name has, like Siberia's, become shorthand for exile. The small dual-prop plane flew northeast for four hours, carrying about a dozen passengers seated on blue-felt seats with the structural integrity of folding chairs. Most were indigenous people from Northeast Siberia. Some brought goods from warmer climes, including crops that can't grow atop the permafrost. One woman held a bucket of grapes between her knees. (28)

We landed in Cherskiy, a dying gold-mining town that sits on the Kolyma River³⁵, a 1,323-mile vein of meltwater, the largest of several that gush out of northeastern Russia and into the East Siberian Sea. Stalin³⁶ built a string of gulags³⁷ along the Kolyma and packed them with prisoners, who were made to work in the local mines. Solzhenitsyn³⁸ called the Kolyma the gulag system's "pole of cold and cruelty." The region retains its geopolitical cachet³⁹ today, on account of its proximity to the Arctic Ocean's vast undersea oil reserves. (29)

Cherskiy's airstrip is one of the world's most remote. Before it became a Cold War stronghold, it was a jumping-off point for expeditions to the North Pole. You need special government permission to fly into Cherskiy. Our plane had just rolled to a halt on the runway's patchy asphalt when Russian soldiers in fatigues boarded and bounded up to the first row of the cabin, where I was sitting with Grant Slater, an American filmmaker who had come with me to shoot footage of Pleistocene Park. I'd secured the required permission, but Slater was a late addition to the trip, and his paperwork had not come in on time. (30)

Nikita Zimov, who met us at the airport, had foreseen these difficulties. Thanks to his lobbying, the soldiers agreed to let Slater through with only 30 minutes of questioning at the local military base. The soldiers wanted to know whether he had ever been to Syria and, more to the point, whether he was an American spy. "It is good to be a big man in a small town," Nikita told us as we left the base. (31)

³⁴ Locate Yakutsk on the map at footnote ³⁵.

³⁵ Download the following [locations](#), and maps, and using the [labeled map](#), [locate the seas, lakes, rivers, countries](#) on the [blank map](#).

³⁶ Stalin: noun: Joseph Stalin: (1879–1953), Soviet statesman; general secretary of the Communist Party of the former Soviet Union 1922–53; born Iosif Vissarionovich Dzhugashvili. In 1928, he launched a succession of five-year plans for rapid industrialization and the enforced collectivization of agriculture. His large-scale purges of the intelligentsia in the 1930s were equally ruthless.

³⁷ gulag(s): noun: a camp in the Gulag system, or any political labor camp; Gulag: noun: a system of labor camps maintained in the Soviet Union from 1930 to 1955 in which many people died

³⁸ Solzhenitsyn: noun: Alexander Solzhenitsyn: (1918–2008), Russian novelist; Russian name Aleksandr Isaevich Solzhenitsyn. After spending eight years in a labor camp, he began writing. He was exiled in 1974 and eventually returned in 1994. Notable works: *One Day in the Life of Ivan Denisovich* (1962), *Cancer Ward* (1968), and *The Gulag Archipelago* (1973). Nobel Prize for Literature (1970).

³⁹ geopolitical cachet: noun: geopolitical: adjective: relating to politics, especially international relations, as influenced by geographical factors; cachet: noun: a distinguishing mark or seal. The cold and cruelty of Cherskiy is a reminder of the cachet of Stalin's prison system called the Gulag Archipelago, a system of labor camps (see above: gulag(s)).

Nikita runs the Northeast Science Station, an Arctic research outpost near Cherskiy⁴⁰, which supports a range of science projects along the Kolyma River, including Pleistocene Park. The station and the park are both funded with a mix of grants from the European Union⁴¹ and America's National Science Foundation⁴². Nikita's family makes the 2,500-mile journey from Novosibirsk to the station every May. In the months that follow, they are joined by a rotating group of more than 60 scientists from around the world. When the sky darkens in the fall, the scientists depart, followed by Nikita's family and finally Nikita himself, who hands the keys to a small team of winter rangers. (32)

We arrived at the station just before dinner. It was a modest place, consisting of 11 hacked-together structures, a mix of laboratories and houses overlooking a tributary⁴³ of the Kolyma. Station life revolves around a central building topped by a giant satellite dish that once beamed propaganda to this remote region of the Soviet empire. (33)

I'd barely stepped through the door that first night when Nikita offered me a beer. "Americans love IPAs⁴⁴," he said, handing me a 32-ounce bottle. He led us into the station's dining hall, a warmly lit, cavernous⁴⁵ room directly underneath the satellite dish. During dinner, one of the scientists told me that the Northeast Science Station ranks second among Arctic outposts as a place to do research, behind only Toolik Field Station in Alaska. Nikita later confided that he felt quite competitive with Toolik. Being far less remote, the Alaskan station offers scientists considerable amenities⁴⁶, including seamless delivery from Amazon Prime. But Toolik provides no alcohol, so Nikita balances its advantages by stocking his station with Russian beer and crystal-blue bottles of Siberian vodka, shipped into Cherskiy at a heavy cost. The drinks are often consumed late at night in a roomy riverside sauna, under a sky streaked pink by the midnight sun. (34)

Nikita is the life of the station. He is at every meal, and any travel, by land or water, must be coordinated through him. His father is harder to find. One night, I caught Sergey alone in the dining room, having a late dinner. Squat and barrel-chested, he was sitting at a long table, his thick gray rope of a ponytail hanging past his tailbone. His beard was a white Brillo Pad

⁴⁰ Cherskiy: on the blank map above, also label [Cherskiy](#)

⁴¹ European Union: noun: an economic and political association of European countries as a unit with internal free trade and common external tariffs

⁴² National Science Foundation: noun: The National Science Foundation (NSF) is an independent agency of the United States government that supports fundamental research and education in all the non-medical fields of science and engineering. Its medical counterpart is the National Institutes of Health. With an annual budget of about US\$7.8 billion (fiscal year 2018), the NSF funds approximately 24% of all federally supported basic research conducted by the United States' colleges and universities. In some fields, such as mathematics, computer science, economics, and the social sciences, the NSF is the major source of federal backing.

⁴³ tributary: noun: a river or stream flowing into a larger river or lake

⁴⁴ IPA: noun: short for Indian pale ale: a type of light-colored beer similar to bitter, typically with a higher than average alcohol and hop content

⁴⁵ cavernous: adjective: giving the impression of vast, dark depth

⁴⁶ amenities: noun: a desirable or useful feature or facility of a building or place

streaked with yellow. He chain-smoked all through the meal, drinking vodka, telling stories, and arguing about Russo-American relations. He kept insisting, loudly and in his limited English, that Donald Trump would be elected president in a few months. (Nikita would later tell me that Sergey has considered himself something of a prophet ever since he predicted the fall of the Soviet Union.) Late in the night, he finally mellowed when he turned to his favorite subjects, the deep past and far future of humankind. Since effectively handing the station over to his son, Sergey seems to have embraced a new role. He has become the station's resident philosopher⁴⁷. (35)

NIKITA WOULD PROBABLY THINK *philosopher* too generous. "My dad likes to lie on the sofa and do science⁴⁸ while I do all the work," he told me the next day. We were descending into an ice cave in Pleistocene Park. Step by cautious step, we made our way down a pair of rickety⁴⁹ ladders that dropped 80 feet through the permafrost to the cave's bottom. Each time our boots found the next rung, we came eye to eye with a more ancient stratum⁵⁰ of chilled soil. Even in the Arctic summer, temperatures in the underground network of chambers were below freezing, and the walls were coated with white ice crystals. I felt like we were wandering around in a geode⁵¹. (36)

Not every wall sparkled with fractals of white frost. Some were windows of clear ice, revealing mud that was 10,000, 20,000, even 30,000 years old. The ancient soil was rich with tiny bone fragments from horses, bison, and mammoths, large animals that would have needed a prolific⁵², cold-resistant food source to survive the Ice Age Arctic. Nikita knelt and scratched at one of the frozen panels with his fingernail. Columns of exhaled steam floated up through the white beam of his headlamp. "See this?" he said. I leaned in, training my lamp on his thumb and forefinger. Between them, he held a thread of vegetable matter so tiny and pale that an errant breath might have reduced it to powder. It was a 30,000-year-old root that had once been attached to a bright-green blade of grass. (37)

For the vast majority of the Earth's 4.5 billion spins around the sun, its exposed, rocky surfaces lay barren. Plants changed that. Born in the seas like us, they knocked against the planet's shores for eons. They army-crawled onto the continents, anchored themselves down, and began testing new body plans, performing, in the process, a series of vast experiments on the Earth's surface. They pushed whole forests of woody stems into the sky to stretch their light-drinking leaves closer to the sun. They learned how to lure pollinators by unfurling perfumed blooms in every color of the rainbow. And nearly 70 million years ago, they began

⁴⁷ philosopher: noun: a person engaged or learned in philosophy, especially as an academic discipline

⁴⁸ science: noun: the intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment

⁴⁹ rickety: adjective: (of a structure or piece of equipment) poorly made and likely to collapse

⁵⁰ stratum: noun (plural **strata**): a layer or a series of layers of rock in the ground

⁵¹ geode: noun: a small cavity in rock lined with crystals or other mineral matter

⁵² prolific: adjective: (of a plant, animal, or person) producing much fruit or foliage or many offspring; present in large numbers or quantities; plentiful

testing a new form that crept out from the shadowy edges of the forest and began spreading a green carpet of solar panel across the Earth. (38)

For tens of millions of years, grasses waged a global land war against forests. According to some scientists, they succeeded by making themselves easy to eat. Unlike other plants, many grasses don't expend energy on poisons, or thorns, or other herbivore-detering technologies. By allowing themselves to be eaten, they partner with their own grazers to enhance⁵³ their ecosystem's nutrient flows. (39)

Temperate-zone biomes⁵⁴ can't match the lightning-fast bio-cycling of the tropics, where every leaf that falls to the steamy jungle floor is set upon by microbial⁵⁵ swarms that dissolve its constituent⁵⁶ parts. In a pine forest, a fallen branch might keep its nutrients locked behind bark and needle for years. But grasslands are able to keep nutrients moving relatively quickly, because grasses so easily find their way into the hot, wet stomachs of large herbivores, which are even more microbe-rich than the soil of the tropics. A grazing herbivore returns nutrients to the soil within a day or two, its thick, paste-like dung acting as a fertilizer to help the bitten blades of grass regrow from below. The blades sprout as if from everlasting ribbon dispensers, and they grow faster than any other plant group on Earth. Some bamboo grasses shoot out of the ground at a rate of several feet a day. (40)

Grasses became the base layer for some of the Earth's richest ecosystems. They helped make giants out of the small, burrowing mammals that survived the asteroid that killed off the dinosaurs some 66 million years ago. And they did it in some of the world's driest regions, such as the sunbaked plains of the Serengeti, where more than 1 million wildebeests still roam. Or the northern reaches of Eurasia during the most-severe stretches of the Pleistocene. (41)

The root between Nikita's thumb and forefinger was one foot soldier among trillions that fought in an ecological revolution that human beings would come to join. We descended, after all, from tree-dwellers. Our nearest primate relatives, chimpanzees, bonobos, and gorillas, are still in the forest. Not human beings. We left Africa's woodlands and wandered into the alien ecology of its grassland savannas, as though sensing their raw fertility. Today, our diets — and those of the animals we domesticated — are still dominated by grasses, especially those we have engineered into mutant strains: rice, wheat, corn, and sugarcane. (42)

"Ask any kid 'Where do animals live?' and they will tell you 'The forest,'" Nikita told me. "That's what people think of when they think about nature. They think of birds singing in a forest. They should think of the grassland." (43)

⁵³ enhance: verb [*with object*]: intensify, increase, or further improve the quality, value, or extent of

⁵⁴ temperate-zone biomes: noun: a large naturally occurring community of plants and animals (biome) in a zone that is not too hot (torrid) and not too cold (frigid).

⁵⁵ microbial: adjective: relating to or characteristic of a microorganism, especially a bacterium causing disease or fermentation

⁵⁶ constituent: adjective: being a part of a whole | noun: a component part of something

Nikita and I climbed out of the ice cave and headed for the park's grassland. We had to cross a muddy drainage channel that he had bulldozed to empty a nearby lake, so that grass seeds from the park's existing fields could drift on the wind and fall onto the newly revealed soil. Fresh tufts of grass were already erupting out of the mud. Nikita does most of his violent gardening with a forest-mowing transporter on tank treads that stands more than 10 feet tall. He calls it the "mama mammoth." (44)

When I first laid eyes on Pleistocene Park, I wondered whether it was the grassland views that first lured humans out of the woods. In the treeless plains, an upright biped⁵⁷ can see almost into eternity. Cool Arctic winds rushed across the open landscape, fluttering its long ground layer of grasses. On the horizon, I made out a herd of large, gray-and-white animals. Their features came into focus as we hiked closer, especially after one broke into a run. They were horses, like those that sprinted across the plains of Eurasia and the Americas during the Pleistocene, their hooves hammering the ground, compressing the snow so that other grazers could reach cold mouthfuls of grass and survive the winter. (45)

Like America's mustangs, Pleistocene Park's horses come from a line that was once domesticated. But it was hard to imagine these horses being tamed. They moved toward us with a boldness you don't often see in pens and barns. Nikita is not a man who flinches easily, but he backpedaled quickly when the horses feinted in our direction. He stooped and gathered a bouquet of grass and extended it tentatively. The horses snorted at the offer. They stared at us, dignified and curious, the mystery of animal consciousness beaming out from the black sheen of their eyes. At one point, four lined up in profile, like the famous quartet of gray horses painted by torchlight on the ceiling of Chauvet Cave, in France, some 30,000 years ago. (46)

We walked west through the fields, to where a lone bison⁵⁸ was grazing. When seen without a herd, a bison loses some of its glamour as a pure symbol of the wild. But even a single hungry specimen is an ecological force to be reckoned with. This one would eat through acres of grass by the time the year was out. In the warmer months, bison expend some of their awesome muscular energy on the destruction of trees. They shoulder into stout trunks, rubbing them raw and exposing them to the elements. It was easy to envision huge herds of these animals clearing the steppes of Eurasia and North America during the Pleistocene. This one had trampled several of the park's saplings, reducing them to broken, leafless nubs. Nikita and I worried that the bison would trample us, too, when, upon hearing us inch closer, he reared up his mighty, horned head, stilled his swishing tail, and stared, as though contemplating⁵⁹ a charge. (47)

⁵⁷ biped: noun: an animal that uses two legs for walking

⁵⁸ bison: noun (plural **same**): a humpbacked shaggy-haired wild ox native to North America and Europe (also called buffalo)

⁵⁹ contemplate: verb [*with object*]: look thoughtfully for a long time at; think about; [*no object*] think profoundly and at length; meditate; have in mind as a probable though not certain intention

We stayed low and headed away to higher ground to see a musk ox⁶⁰, a grazer whose entire being, inside and out, seems to have been carved by the Pleistocene. A musk ox's stomach contains exotic microbiota⁶¹ that are corrosive enough to process tundra scrub. Its dense layers of fur provide a buffer that allows it to graze in perfect comfort under the dark, aurora-filled sky of the Arctic winter, untroubled by skin-peeling, 70-below winds. (48)

Nikita wants to bring hordes of musk oxen to Pleistocene Park. He acquired this one on a dicey boat ride hundreds of miles north into the ice-strewn Arctic Ocean. He would have brought back several others, too, but a pair of polar bears made off with them. Admiring the animal's shiny, multicolored coat, I asked Nikita whether he worried about poachers, especially with a depressed mining town nearby. He told me that hunters from Cherskiy routinely hunt moose, reindeer, and bear in the surrounding forests, "but they don't hunt animals in the park." (49)

"Why?," I asked. (50)

"Personal relationships," he said. "When the leader of the local mafia died, I gave the opening remarks at his funeral." (51)

FILLING PLEISTOCENE PARK with giant herbivores is a difficult task because there are so few left. When modern humans walked out of Africa, some 70,000 years ago, we shared this planet with more than 30 land-mammal species that weighed more than a ton. Of those animals, only elephants, hippos, rhinos, and giraffes remain. These African megafauna⁶² may have survived contact with human beings because they evolved alongside us over millions of years—long enough for natural selection to bake in the instincts required to share a habitat with the most dangerous predator nature has yet manufactured. (52)

The giant animals that lived on other continents had no such luxury. When we first wandered into their midst, they may have misjudged us as small, harmless creatures. But by the time humans arrived in southern Europe, we'd figured out how to fan out across grasslands in small, fleet-footed groups. And we were carrying deadly projectiles that could be thrown from beyond the intimate range of an animal's claws or fangs. (53)

Most ecosystems have checks against runaway predation. Population dynamics usually ensure that apex predators are rare. When Africa's grazing populations dip too low, for instance, lions go hungry and their numbers plummet. The same is true of sharks in the oceans. But when human beings' favorite prey thins out, we can easily switch to plant foods. This omnivorous⁶³ resilience⁶⁴ may explain a mystery that has vexed fossil hunters for more than a

⁶⁰ musk ox: noun: a large heavily built goat-antelope with a thick shaggy coat and large curved horns, native to the tundra of North America and Greenland

⁶¹ exotic microbiota: noun: unordinary microorganisms; in this case, in the stomach of a musk ox

⁶² megafauna: noun: the large animals of a particular region, habitat, or geological era

⁶³ omnivorous: adjective: (of an animal or person) feeding on food of both plant and animal origin

⁶⁴ resilience: noun: the capacity to recover quickly from difficulties

century, as they have slowly unearthed evidence of an extraordinary die-off of large animals all over the world, right at the end of the Pleistocene. (54)

Some scientists think that extreme climate change was the culprit: The global melt transformed land-based biomes, and lumbering megafauna were slow to adapt. But this theory has weaknesses. Many of the vanished species had already survived millions of years of fluctuations between cold and warmth. And with a climate-caused extinction event, you'd expect the effects to be distributed across size and phylum⁶⁵. But small animals mostly survived the end of the Pleistocene. The species that died in high numbers were mammals with huge stores of meat in their flanks—precisely the sort you'd expect spear-wielding humans to hunt. (55)

Climate change may have played a supporting role in these extinctions, but as our inventory of fossils has grown, it has strengthened the case for extermination by human rampage. Most telling is the timeline. Between 40,000 and 60,000 years ago, during an ocean-lowering glaciation, a small group of humans set out on a sea voyage from Southeast Asia. In only a few thousand years, they skittered across Indonesia and the Philippines, until they reached Papua New Guinea and Australia, where they found giant kangaroos, lizards twice as long as Komodo dragons, and furry, hippo-size wombats that kept their young in huge abdominal pouches. Estimating extinction dates is tricky, but most of these species seem to have vanished shortly thereafter. (56)

It took at least another 20,000 years for human beings to trek over the Bering land bridge⁶⁶ to the Americas, and a few thousand more to make it down to the southern tip. The journey seems to have taken the form of an extended hunting spree. Before humans arrived, the Americas were home to mammoths, bear-size beavers, car-size armadillos, giant camels, and a bison species twice as large as those that graze the plains today. The smaller, surviving bison is now the largest living land animal in the Americas, and it barely escaped extermination: The invasion of gun-toting Europeans reduced its numbers from more than 30 million to fewer than 2,000. (57)

The pattern that pairs human arrival with megafaunal extinction is clearest in the far-flung islands that no human visited until relatively recently. The large animals of Hawaii, Madagascar, and New Zealand disappeared during the past 2,000 years, usually within centuries of human arrival. This pattern even extends to ocean ecosystems. As soon as industrial shipbuilding allowed large groups of humans to establish a permanent presence on the seas, we began hunting marine megafauna for meat and lamp oil. Less than a century later, North Atlantic gray whales were gone, along with 95 percent of North Atlantic humpbacks. Not since the asteroid struck have large animals found it so difficult to survive on planet Earth. (58)

⁶⁵ phylum: noun (plural **phyla**): a principal taxonomic category that ranks above class and below kingdom

⁶⁶ Bering land bridge or Bering Strait: noun: a narrow sea passage that separates the eastern tip of Siberia in Russia from Alaska and links the Arctic Ocean with the Bering Sea, about 53 miles (85 km) wide at its narrowest point. During the Ice Age as a result of a drop in sea levels, the Bering land bridge formed between the two continents, allowing the migration of animals and dispersal of plants in both directions.

IN NATURE, no event happens in isolation. A landscape that loses its giants becomes something else. Nikita and I walked all the way to the edge of Pleistocene Park, to the border between the grassy plains and the forest, where a line of upstart saplings was shooting out of the ground. Trees like these had sprung out of the soils of the Northern Hemisphere for ages, but until recently, many were trampled or snapped in half by the mighty, tusked force of the woolly mammoth. (59)

It was only 3 million years ago that elephants left Africa and swept across southern Eurasia. By the time they crossed the land bridge to the Americas, they'd grown a coat of fur. Some of them would have waded into the shallow passes between islands, using their trunks as snorkels. In the deserts south of Alaska, they would have used those same trunks to make mental scent maps of water resources, which were probably sharper in resolution than a bloodhound's. (60)

The mammoth family assumed new forms in new habitats, growing long fur in northern climes and shrinking to pygmies on Californian islands where food was scarce. But mammoths were always a keystone species on account of their prodigious grazing, their well-digging, and the singular joy they seemed to derive from knocking down trees. A version of this behavior is on display today in South Africa's Kruger National Park, one of the only places on Earth where elephants live in high densities. As the population has recovered, the park's woodlands have thinned, just as they did millions of years ago, when elephants helped engineer the African savannas that made humans into humans. (61)

I have often wondered whether the human who first encountered a mammoth retained some cultural memory of its African cousin, in song or story. In the cave paintings that constitute our clearest glimpse into the prehistoric mind, mammoths loom large. In a single French cave, more than 150 are rendered in black outline, their tusks curving just so. In the midst of the transition from caves to constructed homes, some humans lived *inside* mammoths: 15,000 years ago, early architects built tents from the animals' bones and tusks. (62)

Whatever wonderment human beings felt upon sighting their first mammoth, it was eventually superseded by more-practical concerns. After all, a single cold-preserved carcass could feed a tribe for a few weeks. It took less than 50 millennia for humans to help kill off the mammoths of Eurasia and North America. Most were dead by the end of the Ice Age. A few survived into historical times, on remote Arctic Ocean outposts like St. Paul Island, a lonely dot of land in the center of the Bering Sea where mammoths lived until about 3600 B.C. A final group of survivors slowly wasted away on Wrangel Island, just north of Pleistocene Park. Mammoth genomes tell us they were already inbreeding when the end came, around 2000 B.C. No one knows how the last mammoth died, but we do know that humans made landfall on Wrangel Island around the same time. (63)

The mammoth's extinction may have been our original ecological sin. When humans left Africa 70,000 years ago, the elephant family occupied a range that stretched from that continent's southern tip to within 600 miles of the North Pole. Now elephants are holed up in a few final hiding places, such as Asia's dense forests. Even in Africa, our shared ancestral

home, their populations are shrinking, as poachers hunt them with helicopters, GPS, and night-vision goggles. If you were an anthropologist specializing in human ecological relationships, you may well conclude that one of our distinguishing features as a species is an inability to coexist peacefully with elephants. (64)

But nature isn't fixed, least of all human nature. We may yet learn to live alongside elephants, in all their spectacular variety. We may even become a friend to these magnificent animals. Already, we honor them as a symbol of memory, wisdom, and dignity. With luck, we will soon re-extend their range to the Arctic. (65)

"Give me 100 mammoths and come back in a few years," Nikita told me as he stood on the park's edge, staring hard into the fast-growing forest. "You won't recognize this place." (66)

THE NEXT MORNING, I met Sergey Zimov on the dock at the Northeast Science Station. In winter, when Siberia ices over, locals make long-distance treks on the Kolyma's frozen surface, mostly in heavy trucks, but also in the ancestral mode: sleighs pulled by fleet-footed reindeer. (Many far-northern peoples have myths about flying reindeer.) Sergey and I set out by speedboat, snaking our way down from the Arctic Ocean and into the Siberian wilderness. (67)

Wearing desert fatigues and a black beret, Sergey smoked as he drove, burning through a whole pack of unfiltered cigarettes. The twin roars of wind and engine forced him to be even louder and more aphoristic⁶⁷ than usual. Every few miles, he would point at the young forests on the shores of the river, lamenting their lack of animals. "This is not wild!" he would shout. (68)

It was early afternoon when we arrived at Duvanny Yar, a massive cliff that runs for six miles along the riverbank. It was like no other cliff I'd ever seen. Rising 100 feet above the shore, it was a concave checkerboard of soggy mud and smooth ice. Trees on its summit were flopping over, their fun-house angles betraying the thaw beneath. Its aura⁶⁸ of apocalyptic decay was enhanced by the sulfurous smell seeping out of the melting cliffside. As a long seam of exposed permafrost, Duvanny Yar is a vivid window into the brutal geological reality of climate change. (69)

Many of the world's far-northern landscapes, in Scandinavia, Canada, Alaska, and Siberia, are wilting like Duvanny Yar is. When Nikita and I had driven through Cherskiy, the local mining town, we'd seen whole houses sinking into mud formed by the big melt. On YouTube, you can watch a researcher stomp his foot on Siberian scrubland, making it ripple like a water bed. The northern reaches of the taiga are dimpled with craters hundreds of feet across, where frozen underground soil has gone slushy and collapsed, causing landslides that have sucked

⁶⁷ aphoristic: adjective: having the characteristic of an aphorism: noun: a pithy observation that contains a general truth, such as, "if it ain't broke, don't fix it."

⁶⁸ aura: noun (plural **auras** or **aurae**): the distinctive atmosphere or quality that seems to surround and be generated by a person, thing, or place

huge stretches of forest into the Earth. The local Yakutians describe one of the larger sinkholes as a “gateway to the underworld.” (70)

As the Duvanny Yar cliffside slowly melts into the Kolyma River, it is spilling Ice Age bones onto the riverbank, including woolly-rhino ribs and mammoth tusks worth thousands of dollars. A team of professional ivory hunters had recently picked the shore clean, but for a single 30-inch section of tusk spotted the previous day by a lucky German scientist. He had passed it around the dinner table at the station. Marveling at its smooth surface and surprising heft⁶⁹, I’d felt, for a moment, the instinctive charge of ivory lust, that peculiar human longing that has been so catastrophic for elephants, furry and otherwise. When I joked with Sergey that fresh tusks may soon be strewn across this riverbank, he told me he hoped he would be alive when mammoths return to the park. (71)

The first of the resurrected mammoths will be the loneliest animal on Earth. Elephants are extremely social. When they are removed from normal herd life to a circus or a zoo, some slip into madness. Mothers even turn on their young. (72)

Elephants are matriarchal⁷⁰: Males generally leave the herd in their teens, when they start showing signs of sexual maturity. An elephant’s social life begins at birth, when a newborn calf enters the world to the sound of joyous stomping and trumpeting from its sisters, cousins, aunts, and, in some cases, a grandmother. (73)

Mammoth herds were likewise matriarchal, meaning a calf would have received patient instruction from its female elders. It would have learned how to use small sticks to clean dirt from the cracks in its feet, which were so sensitive that they could feel the steps of a distant herd member. It would have learned how to wield a trunk stuffed with more muscles than there are in the entire human body, including those that controlled its built-in water hose. It would have learned how to blast trumpet notes across the plains, striking fear into cave lions, and how to communicate with its fellow herd members in a rich range of rumbling sounds, many inaudible to the human ear. (74)

The older mammoths would have taught the calf how to find ancestral migration paths, how to avoid sinkholes, where to find water. When a herd member died, the youngest mammoth would have watched the others stand vigil, tenderly touching the body of the departed with their trunks before covering it with branches and leaves. No one knows how to re-create this rich mammoth culture, much less how to transmit it to that cosmically bewildered first mammoth. (75)

Or to an entire generation of such mammoths. The Zimovs won’t be able to slow the thawing of the permafrost if they have to wait for their furry elephant army to grow organically. That would take too long, given the species’ slow breeding pace. George Church, the Harvard geneticist, told me he thinks the mammoth-manufacturing process can be industrialized, complete with synthetic-milk production, to create a seed population that numbers in the tens of thousands. But he didn’t say who would pay for

⁶⁹ heft: noun: the weight of someone or something

⁷⁰ matriarchal: adjective: relating to or denoting a form of social organization in which a woman is the head

it—at the Northeast Science Station, there was open talk of recruiting a science-friendly Silicon Valley billionaire—or how the Zimovs would deploy such a large group of complex social animals that would all be roughly the same age. (76)

Nikita and Sergey seemed entirely unbothered by ethical considerations regarding mammoth cloning or geoengineering. They saw no contradiction between their veneration of “the wild” and their willingness to intervene, radically, in nature. At times they sounded like villains from a Michael Crichton novel. Nikita suggested that such concerns reeked of a particularly American piety. “I grew up in an atheist country,” he said. “Playing God doesn’t bother me in the least. We are already doing it. Why not do it better?” (77)

Sergey noted that other people want to stop climate change by putting chemicals in the atmosphere or in the ocean, where they could spread in dangerous ways. “All I want to do is bring animals back to the Arctic,” he said. (78)

As Sergey and I walked down the riverbank, I kept hearing a cracking sound coming from the cliff. Only after we stopped did I register its source, when I looked up just in time to see a small sheet of ice dislodge from the cliffside. Duvanny Yar was bleeding into the river before our very eyes. (79)

In 1999, Sergey submitted a paper to the journal *Science* arguing that Beringian permafrost contained rich “yedoma” soils left over from Pleistocene grasslands. (In other parts of the Arctic, such as Norway and eastern Canada, there is less carbon in the permafrost; if it thaws, sea levels will rise, but much less greenhouse gas will be released into the atmosphere.) When Beringia’s pungent⁷¹ soils are released from their icy prison, microbes devour the organic contents, creating puffs of carbon dioxide. When this process occurs at the bottom of a lake filled with permafrost melt, it creates bubbles of methane that float up to the surface and pop, releasing a gas whose greenhouse effects are an order of magnitude worse than carbon dioxide’s. Already more than 1 million of these lakes dot the Arctic, and every year, new ones appear in NASA satellite images, their glimmering surfaces steaming methane into the closed system that is the Earth’s atmosphere. If huge herds of megafauna recolonize the Arctic, they too will expel methane, but less than the thawing frost, according to the Zimovs’ estimates. (80)

Science initially rejected Sergey’s paper about the danger posed by Beringia’s warming. But in 2006, an editor from the journal asked Sergey to resubmit his work. It was published in June of that year. Thanks in part to him, we now know that there is more carbon locked in the Arctic permafrost than there is in all the planet’s forests and the rest of the atmosphere combined. (81)

FOR MY LAST DAY in the Arctic, Nikita had planned a send-off. We were to make a day trip, by car, to Mount Rodinka, on Cherskiy’s outskirts. Sergey came along, as did Nikita’s daughters and one of the German scientists. (82)

⁷¹ pungent: adjective: having a sharply strong taste or smell

Rodinka is referred to locally as a mountain, though it hardly merits the term. Eons of water and wind have rounded it down to a dark, stubby hill. But in Siberia's flatlands, every hill is a mountain. Halfway up to the summit, we already had a God's-eye view of the surrounding landscape. The sky was lucid⁷² blue but for a thin mist that hovered above the Kolyma River, which slithered, through a mix of evergreens and scrub, all the way to the horizon. At the foot of the mountain, the gold-mining town and its airstrip hugged the river. In the dreamy, deep-time atmosphere of Pleistocene Park, it had been easy to forget this modern human world outside the park's borders. (83)

Just before the close of the 19th century, in the pages of this magazine, John Muir⁷³ praised the expansion of Yellowstone, America's first national park. He wrote of the forests, yes, but also of the grasslands, the "glacier meadows" whose "smooth, silky lawns" pastured "the big Rocky Mountain game animals." Already the park had served "the furred and feathered tribes," he wrote. Many were "in danger of extinction a short time ago," but they "are now increasing in numbers." (84)

Yellowstone's borders have since been expanded even farther. The park is now part of a larger stretch of land cut out from ranches, national forests, wildlife refuges, and even tribal lands. This Greater Yellowstone Ecosystem is 10 times the size of the original park, and it's home to the country's most populous wild-bison herd. There is even talk of extending a wildlife corridor to the north, to provide animals safe passage between a series of wilderness reserves, from Glacier National Park to the Canadian Yukon. But not everyone supports Yellowstone's outward expansion. The park is also home to a growing population of grizzly bears, and they have started showing up in surrounding towns. Wolves were reintroduced in 1995, and they, too, are now thriving. A few have picked off local livestock. (85)

Sergey sees Pleistocene Park as the natural next step beyond Yellowstone in the rewilding of the planet. But if Yellowstone is already meeting resistance as it expands into the larger human world, how will Pleistocene Park fare if it leaves the Kolyma River basin and spreads across Beringia? (86)

The park will need to be stocked with dangerous predators. When they are absent, herbivore herds spread out, or they feel safe enough to stay in the same field, munching away mindlessly until it's overgrazed. Big cats and wolves force groups of grazers into dense, watchful formations that move fast across a landscape, visiting a new patch of vegetation each day in order to mow it with their teeth, fertilize it with their dung, and trample it with their many-hooved plow. Nikita wants to bring in gray wolves, Siberian tigers, or cold-adapted Canadian cougars. If it becomes a trivial challenge to resurrect extinct species, perhaps he could even repopulate Siberia with cave lions and dire wolves. But what will happen when one of these predators wanders onto a city street for the first time? (87)

⁷² lucid: adjective: bright or luminous

⁷³ John Muir: noun: (1834-1914), US naturalist, born in Scotland. An early advocate of wilderness preservation, he founded the Sierra club in 1892.

“This is a part of the world where there is very little agriculture, and very few humans,” Sergey told me. He is right that Beringia is sparsely populated, and that continuing urbanization will likely clear still more space by luring rural populations into the cities. But the region, which stretches across Alaska and the Canadian Yukon, won’t be empty anytime soon. Fifty years from now, there will still be mafia leaders to appease, not to mention indigenous groups and the governments of three nations, including two that spent much of the last century vying for world domination. America and Russia often cooperate in the interest of science, especially in extreme environments like Antarctica and low-Earth orbit, but the Zimovs will need a peace that persists for generations. (88)

Sergey envisions a series of founding parks, “maybe as many as 10,” scattered across Beringia. One would be along the Yentna River, in Alaska, another in the Yukon. A few would be placed to the west of Pleistocene Park, near the Ural mountain range, which separates Siberia from the rest of Russia. As Sergey spoke, he pointed toward each of these places, as if they were just over the horizon and not thousands of miles away. (89)

Sergey’s plan relies on the very climate change he ultimately hopes to forestall. “The top layer of permafrost will melt first,” he said. “Modern ecosystems will be destroyed entirely. The trees will fall down and wash away, and grasses will begin to appear.” The Mammoth Steppe would spread from its starting nodes in each park until they all bled into one another, forming a megapark that spanned the entire region. Humans could visit on bullet trains built on elevated tracks, to avoid disturbing the animals’ free movement. Hunting could be allowed in designated areas. Gentler souls could go on Arctic safari tours. (90)

When Sergey was out of earshot, I asked Nikita whether one of his daughters would one day take over Pleistocene Park to see this plan through. We were watching two of them play in an old Soviet-military radar station, about 100 yards from Rodinka’s peak. (91)

“I took the girls to the park last week, and I don’t think they were too impressed,” Nikita told me, laughing. “They thought the horses were unfriendly.” I told him that wasn’t an answer. “I’m not as selfish as my father,” he said. “I won’t force them to do this.” (92)

Before I left to catch a plane back to civilization, I stood with Sergey on the mountaintop once more, taking in the view. He had slipped into one of his reveries about grasslands full of animals. He seemed to be suffering from a form of solastalgia, a condition described by the philosopher Glenn Albrecht as a kind of existential grief for a vanished landscape, be it a swallowed coast, a field turned to desert, or a bygone geological epoch. He kept returning to the idea that the wild planet had been interrupted midway through its grand experiment, its 4.5-billion-year blending of rock, water, and sunlight. He seems to think that the Earth peaked during the Ice Age, with the grassland ecologies that spawned human beings. He wants to restore the biosphere to that creative summit, so it can run its cosmic experiment forward in time. He wants to know what new wonders will emerge. “Maybe there will be more than one animal with a mind,” he told me. (93)

I don’t know whether Nikita can make his father’s mad vision a material reality. The known challenges are immense, and there are likely many more that he cannot foresee.

But in this brave new age when it is humans who make and remake the world, it is a comfort to know that people are trying to summon whole landscapes, Lazarus-like⁷⁴, from the tomb. “Come forth,” they are saying to woolly mammoths. Come into this habitat that has been prepared for you. Join the wolves and the reindeer and the bison who survived you. Slip into your old Ice Age ecology. Wander free in this wild stretch of the Earth. Your kind will grow stronger as the centuries pass. This place will overflow with life once again. Our original sin will be wiped clean. And if, in doing all this, we can save our planet and ourselves, that will be the stuff of a new mythology. (94)

⁷⁴ Lazarus of Bethany: noun: a Biblical figure described as being raised from the dead