

**HOW
TO TAME
A FOX**

(AND BUILD A DOG)

*Visionary Scientists and a Siberian Tale
of Jump-Started Evolution*

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A Bold Idea

One afternoon in the fall of 1952, thirty-five-year-old Dmitri Belyaev, clad in his signature dark suit and tie, boarded the overnight train from Moscow to Tallinn, the capital of Estonia on the coast of the Baltic Sea. Across the waters from Finland, but at the time, a world away, Tallinn was shrouded behind the Iron Curtain that divided Eastern and Western Europe after World War II. Belyaev was on his way to speak with a trusted colleague, Nina Sorokina, who was the chief breeder at one of the many fox farms he collaborated with in developing breeding techniques. Trained as a geneticist, he was a lead scientist at the government-run Central Research Laboratory on Fur Breeding Animals in Moscow, charged with helping breeders at the many commercial fox and mink farms run by the government to produce more beautiful and luxurious furs. Belyaev was hoping that Sorokina would agree to help him test a theory he had about how the domestication of animals had come about, one of the most beguiling open questions in animal evolution.

He carried with him several packs of cigarettes, a simple meal of hard-boiled eggs and hard salami, and a number of books and scientific papers. A voracious reader, he always traveled with a good

novel or book of plays or poems, along with a number of science books and papers, on his many long train rides to the fox and mink farms scattered across the vast expanses of the Soviet Union. Even as he was intent to keep up with the rush of important new findings and theories in genetics and animal behavior pouring out of labs in Europe and the US, he always made time for his love of Russian literature. He was a particular enthusiast of works reflecting on the hardships endured by his countrymen through hundreds of years of political turmoil, works that were all too relevant to the upheavals Stalin had inflicted on the Soviet Union since his ascent to power decades earlier.

Dmitri's taste in literature ranged from the cunning folktales of the country's beloved storyteller Nikolai Leskov, in which unschooled peasants often outwit their more learned superiors, to the mystical poetry of Alexander Blok, who wrote presciently shortly before the 1917 revolution that "a great event was coming." One of his favorite works was the play *Boris Godunov*, by Russia's great nineteenth-century poet and playwright Alexander Pushkin. A cautionary tale inspired by Shakespeare's Henry plays, it recounts the tempestuous reign of the popular reformist tsar, who opened up trade with the West and instituted educational reform, but also dealt harshly with his enemies. Godunov's sudden death from a stroke in 1605 ushered in the bloody era of civil war known as the Time of Troubles. That brutal period 350 years ago was mirrored in the terror and devastation Stalin had perpetuated as Dmitri was growing up in the 1930s and '40s. Stalin's purges and his ill-conceived agricultural policies produced wave after wave of famine.

Stalin had also supported a brutal crackdown on work in genetics, and in 1952 it was still a very dangerous time to be a geneticist in Russia. Belyaev followed the new developments in the field at great risk to himself and his career. With Stalin's backing, for more than a decade Trofim Lysenko, a charlatan who posed as a scientist, had wielded enormous influence over the Soviet scientific community, and one of his primary causes was a vehement crusade against genetics research. Many of the best researchers had been deposed

from their positions, either thrown into prison camps or forced to resign and accept menial positions. Some had been killed, including Dmitri's older brother, who was a leading light in the field. Before Lysenko's rise to power, Russia was a world leader in genetics. A number of the best Western geneticists—such as American Herman Muller—had even made the long journey east for the chance to work with Soviet geneticists. Now Russian genetics was in a shambles, with any kind of serious research strictly prohibited.

But Dmitri was determined not to allow Lysenko and his thugs to keep him from conducting research. His work in fox and mink breeding had given him an idea about the great outstanding mystery of domestication, and it was simply too good for him not to find a way to test it.

The methods of breeding employed by our ancestors who domesticated the sheep, goats, pigs, and cows that were so vital to the development of civilization were well understood. Dmitri employed them in his work every day at fox and mink farms. But the question of how domestication had gotten started in the first place had remained a riddle. The ancestors of domesticated animals, in their wild state, would likely have simply run away in fear or attacked if a human had approached. What happened to change this and make breeding them possible?

Belyaev thought he might have found the answer. Paleontologists had argued that the first animal to be domesticated was the dog, and by this time, evolutionary biologists were sure that dogs evolved from wolves. Dmitri had become fascinated by the question how an animal as naturally averse to human contact, and as potentially aggressive as a wolf, had evolved over tens of thousands of years into the lovable, loyal dog. His work breeding foxes had provided him an important clue, and he wanted to test the theory he was still in the early stages of developing. He thought he knew what had first set the process in motion.

Belyaev was traveling to Tallinn to ask Nina Sorokina to help him get started on a bold and unprecedented project—he wanted to mimic the evolution of the wolf into the dog. Because the fox is

a close genetic cousin of the wolf, it seemed plausible to him that whatever genes were involved in the evolution of wolves into dogs were shared by the silver foxes raised on the farms all over the Soviet Union.¹ As a lead scientist at the Central Research Laboratory on Fur Breeding Animals, he was in the perfect position to conduct the experiment he had in mind. Dmitri's breeding work was of such importance to the Soviet government, because of the badly needed foreign currency the sale of furs brought into the government's coffers, that he believed as long as he explained the experiment as an effort to improve the production of furs, it could be run safely.

Even so, the fox domestication experiment he had in mind was sufficiently risky that it would have to be run far away from the prying eyes of Lysenko's goons in Moscow. That's why Dmitri had decided to ask Nina to help him get it started under the auspices of her breeding program at a fox farm in faraway Tallin. He had collaborated with her on several successful projects to produce shinier and silkier furs, and he knew she was very talented. They had developed a good relationship, and Dmitri believed he could trust her and that she would trust him.

His plan for the experiment was on a scale never before carried out in genetic research, which worked primarily with tiny viruses and bacteria, or fast-breeding flies and mice, not animals like foxes, which mate only once a year. Due to the time it would take to breed each generation of foxes, the experiment might take many years to produce results, perhaps even decades, or longer. But he felt launching it was worth both the long commitment and the risk. If it did produce results, they might well be groundbreaking.

DMITRI BELYAEV WAS NOT A MAN TO shy away from danger, and he understood how to use the considerable tools he had to negotiate the treacherous waters of Stalin's rule. When World War II broke out, he immediately joined the Soviet army and fought valiantly against the Germans on the front, rising to the rank of major by war's end, though he was only twenty-eight. Both his military service and his skill in fur breeding, producing gorgeous furs that

fetches high prices, had won him the trust of his government superiors, and he had developed a reputation as both a first-rate scientist and a man who knew how to get things done. Dmitri also knew how to make good use of his considerable charm, and the mesmerizing effect he had on people, to burnish his reputation.

Belyaev was a strikingly handsome man, with a strong jaw, thick coal-black hair, and penetrating dark-brown eyes. His confidence and dignified bearing lent him a commanding presence, though he stood only five feet eight inches tall. No one who worked with him, or even just met him briefly, failed to comment about the extraordinary power of his eyes when asked to describe him. “When he was looking at you,” one colleague recalled, “he was looking through you, reading your mind. Some people didn’t like to go to his office, not because they had done something wrong or they were afraid of being punished. They were scared by his eyes, by his gaze.” Belyaev understood this effect well and he would often intently lock people in his gaze when he spoke with them. It seemed impossible to keep anything from him or to deceive him.

His demanding standards of excellence were profoundly inspiring for some of his scientific colleagues and those who worked for him, and many of them were intensely devoted to him. He gave them confidence and pushed them to do their best work, constantly probing into new avenues of inquiry with them. A believer in lively debate, he encouraged open discussion of alternative views, and he loved volleying ideas back and forth. Some of those who worked with him weren’t so enamored of his leadership, however, intimidated by his intensity and unbridled energy, while others feared his disdain for any shirking of responsibility or any sort of gossip or intrigue. He knew those he could expect first-rate work from and trust and those he could not. Nina Sorokina was one of those he could have faith in on both counts.

Disembarking from his long train journey to Tallinn, Dmitri boarded a local bus heading south, traveling roads so bumpy they barely merited the name, through many tiny villages. His destination was the little hamlet of Kohila, buried deep in the Estonian for-

est. Not so much a village as a corporate outpost, Kohila was typical of the dozens of these industrial-scale fur farms scattered across the region.² Spread out over 150 acres, the farm housed about 1500 silver foxes in dozens of rows of metal-roofed long wooden sheds, each of which contained dozens of cages. The workers and their families lived a ten-minute walk away from the farm in a bare-bones settlement of drab housing units, a small school, a few shops, and a couple of social clubs.

Nina Sorokina struck a somewhat incongruous figure against the dreary backdrop of this remote outpost. She was a beautiful, dark-haired woman, also in her mid-thirties, keenly intelligent and intense about her work, commanding a powerful position for a woman in such a vital industry. A welcoming host, she enjoyed inviting Dmitri for tea in her office whenever he visited the farm. When he arrived after his long journey, they went right away to her office to talk in private. Over tea and cakes, with an ever-present cigarette dangling from his mouth, he told her what he was proposing—to domesticate the silver fox. She would not have been unreasonable to think her friend somewhat mad. Most of the foxes at the fur farms were so aggressive that when caretakers and breeders approached them, they bared their sharp canine teeth and lunged at them, snarling viciously. When foxes bite, they bite hard, and Nina and her team of breeders wore two-inch thick protective gloves that rode halfway up their forearms when they got anywhere near these animals. But Nina was intrigued, and she asked him why he wanted to attempt this.

He told her that he had been fascinated by the unanswered questions about domestication, and that he was especially taken by the puzzle as to why domesticated animals could breed more than once a year, but their wild ancestors rarely did. If he could domesticate foxes, they might also be able to breed more often, which would be very good for business. This answer was true, but it was also good cover for her and her breeding team. If anyone should ask what they were doing, they could say that they were studying fox behavior and fox physiology, which were acceptable areas of research to Lysenko,

in order to see if they could increase fur quality and the number of pups born each year. How could the authorities object to that?

He didn't want to put Nina at risk by explaining more. The full truth was that if the experiment worked, it might provide the answers to many important outstanding questions about domestication in all species. The more Belyaev had researched what was known about how animals had become domesticated, the more intrigued he had become by the mysteries about it, and those were mysteries that only an experiment of the kind he was proposing would be able to solve. How else could the answer to how domestication got started possibly be found? No written accounts of this first stage of the process were available. And though fossils of the early stages of domesticates such as dog-like wolves and early versions of domesticated horses had been found, they could reveal little about how the process got going in the first place. Even if remains could eventually be found that established what the first changes in animals' physiology had been, that would not explain how and why they emerged.

A number of other puzzles about domestication also had not been solved. One was why so few animal species out of the millions on the planet had become domesticated—only a few dozen in all, most of which were mammals, but which also included a few species of fish and birds, and a few insects, including the silk moth and the honeybee. Then there was the question why so many of the changes that had taken place in domesticated mammals were so similar. As Darwin, one of Dmitri's intellectual idols, had noted, most of them developed patches of different coloring in their fur and on their hides—spots, patches, blazes, and other markings. Many also retained physical characteristics from childhood well into their adulthood that their wild cousins outgrew, such as floppy ears, curly tails, and babyish faces—referred to as the neotonic features, those that make young animals of so many species so adorable. Why would these characteristics have been selected for by breeders? Farmers raising cows, after all, had nothing to gain from their cows having black-and-white spotted hides. Why would pig farmers have cared whether their pigs had curly tails?

Perhaps these changes in the animals' characteristics had arisen not from the artificial selection process involved in breeding by humans, but through natural selection. After all, natural selection continues to operate on species after they've been domesticated, just to a lesser degree than in the wild. Animals in the wild develop all sorts of spots and stripes and other patterns in their fur and hides, which often serve the purpose of camouflaging them. The spots and patches domestic animals develop don't play this camouflaging role, though, so why would selection favor them? There must be another answer.

Another commonality among domesticated animals concerns their mating abilities. All wild mammals breed within a particular window of time each year, and only once a year. For some, that window is as narrow as a few days and for others it's weeks or even months. Wolves, for example, breed between January and March. The window for foxes is from January to late February. This time of year corresponds to the optimal conditions for survival; the young are born when the temperature, the amount of light, and the abundance of food offer them the best odds for a successful launch into the world. With many domesticated species, by contrast, mating can occur any time during the year and for many, more than once. Why had domestication led to such a profound change in the reproductive biology of animals?

Belyaev thought the answer to all of the puzzling questions about domestication had to do with the essential defining characteristic of all domesticated animals—their tameness. He believed that the process of domestication was driven by our ancestors selecting animals according to this one key trait—that they were less aggressive and fearful toward humans than was typical for their species. This characteristic of tameness would have been the essential requirement for working with the animals in order to breed them for other desirable traits. Humans needed their cows, horses, goats, sheep, pigs, dogs, and cats to be nice and gentle toward their masters, regardless of what they were trying to get from them—milk,

meat, protection, or companionship. It wouldn't do to be trampled by their food or maimed by their protectors.

Belyaev explained to Nina that in his work in fox and mink breeding he had noted that while most of the minks and foxes on the fur farms were either quite aggressive or were nervous and fearful towards people, a few were quite calm when people approached them. They weren't bred to be calm, so the quality must have been part of the natural behavioral variation in a population. This, he posited, would have been true for the ancestors of all domesticates. And over evolutionary time, as our early ancestors had begun raising them and selecting for this innate tameness, the animals became more and more docile. He thought that all of the other changes involved in domestication had been triggered by this change in the behavioral selection pressure for tameness. Rather than either avoidance of humans or aggression towards them giving them the survival advantage, now being calm around humans gave them the edge. The animals living in human contact had more reliable access to food and were better protected from predators. He wasn't sure yet how selection for tameness would have caused all the genetic changes that must have happened in the animals, but he had conceived of an experiment he hoped would eventually provide the answer.

Nina was all ears. She had also observed that some foxes, though very few, were quite calm when approached, and she was intrigued by his theory. Belyaev explained the procedure he wanted Nina and her breeding team to follow. Every year, they should choose a few of the calmest foxes at Kohila at the breeding time in late January and mate them with one another. From the pups that those select foxes produced they should again choose the calmest ones and breed them. The change from generation to generation might be subtle, he noted, even difficult to identify at first glance, but they should just use their best judgment. Perhaps, he suggested, this method would eventually lead to calmer and calmer foxes, the first step in domestication.

Dmitri suggested that Nina and her breeders assess calmness by

observing closely how the foxes responded when they approached their cages or put their hands up in front of them. They might even try putting a sturdy stick slowly through the bars of the cage to see whether the foxes attacked it or held back. But he would leave it up to them to work out their methods; he was confident in Nina's judgment. Nina, in return, had faith that Dmitri's idea was worth pursuing.

Before she agreed, he wanted to discuss the risks. He knew Nina understood the danger of conducting an experiment in the genetics of domestication under Lysenko, but he nonetheless emphasized to her that she must carefully consider the issue. He told her it was probably a good idea not to mention the work to others, except her team, and he offered his suggestion that if she were asked about what they were doing, she could say that the purpose of the experiment was simply to see if they could increase fur quality and the number of pups born each year.

Without a moment's pause, Nina told him she would help him. She and her team would begin right away.

NINA'S AGREEMENT TO HELP WITH THE EXPERIMENT meant a great deal to Belyaev. This work, he hoped, could be the beginning of important research, which, if he was right about domestication, might even lead to breakthrough findings. It would also be keeping the tradition of such pathbreaking work in Soviet genetics alive, which was an urgent mission for him.

Dmitri believed that his generation of researchers must revive that tradition. This experiment, he felt sure, was the best way in which he could do his part. He and his fellow geneticists couldn't allow Lysenko and his gang to hold back serious work any longer. Before long, scientists in the West were sure to crack the genetic code, figuring out how genes were constructed and how they sent messages to the cells that determined virtually everything about how animals developed and how day-to-day life is governed. Soviet geneticists must contribute to this new scientific revolution. It was time to build anew on the pioneering work in genetics that his older

brother and so many of his scientific heroes had sacrificed their careers, and sometimes their lives, for.

One of those pioneers who had given their lives for the cause of genetics was a particular inspiration to Dmitri in studying domestication. Nikolai Vavilov greatly furthered our understanding of plant domestication and was also one of the world's most important botanical explorers. He traveled to some sixty-four countries collecting seeds that were vital sources of food for the world—and for Russia. In his lifetime alone, three terrible famines in Russia killed millions of people and Vavilov had dedicated his life to finding ways to propagate crops for his country. He had started collecting seeds in 1916 and his work represented a high standard of research and perseverance that Dmitri hoped to honor. Vavilov had suffered what might have been a crushing loss right at the start of his career. Returning from England during World War I, where he had studied with some of the world's leading geneticists, armed with a treasury of plant samples he planned to use in his research, his ship struck a German mine and was sunk. All the plants were lost.

Undeterred, Vavilov launched into a new research program, searching for crop varieties that were less susceptible to disease. In time, he collected domesticated plants from all around the world, which ultimately took him to the most remote jungles, forests, and mountains looking for the birthplaces of domesticated species.³ Reputed to sleep only four hours a night, he apparently used the extra time to write more than 350 papers and numerous books, as well as to master more than a dozen languages. He wanted to be able to talk with local farmers and villagers so that he could learn everything they knew about the plants he was studying.

Vavilov's collecting adventures are the stuff of legend and began with a journey to Iran and Afghanistan, followed by visits to Canada and the United States in 1921; Eritrea, Egypt, Cyprus, Crete, and Yemen in 1926; and China in 1929.⁴ On his first trip, he was arrested at the Iran-Russia border and accused of being a spy, because he had a few German textbooks with him. In the Palmir region of central Asia, he was abandoned by his guide, ditched from his caravan, and

attacked by robbers. On a trip to the border of Afghanistan, when he fell as he was stepping between two train cars, he was left dangling by his elbows as the train roared along. On a trip to Syria he contracted malaria *and* typhus, but carried on. One of his biographers wrote of his superhuman intensity, “For six weeks he did not even take off his overcoat. During the day he travelled and collected. When night came he flung himself on to the floor of some native hut. . . . Dysentery afflicted him throughout his expedition but he returned with several thousand specimens.”⁵ Indeed, he collected more live plant specimens than any man or woman in history, and he set up hundreds of field stations for others to continue his work. His vast collection of plant species allowed him to identify eight centers of world plant domestication; in southwestern Asia, southeastern Asia, the Mediterranean, Ethiopia, Abyssinia, the Mexican-Peruvian region, the Chiloe archipelago (near Chile), the border of Brazilian and Paraguay, and one island center, near Indonesia.

Vavilov had actually befriended the young Lysenko in the 1920s, when Lysenko received national acclaim for conducting research to help increase crop yields, a mission that was so important to Vavilov. So taken by Lysenko’s claims for his research in plant breeding was Vavilov at first that he went so far as to nominate him for membership in the Ukrainian Academy of Sciences. Lysenko’s claims about improving crop yields were also what, tragically, brought him to Stalin’s attention. His rise to power over Soviet science is a story worthy of Dmitri’s beloved Pushkin.

It all started when, in the mid-1920s, the Communist Party leadership elevated a number of uneducated men from the proletariat into positions of authority in the scientific community, as part of a program to glorify the “average man” after centuries of monarchy had perpetuated wide class divisions between the wealthy and the workers and peasants. Lysenko fit the bill perfectly, having been raised by peasant farmer parents in the Ukraine.⁶ He hadn’t even learned to read until he was thirteen, and he had no university degree, having studied at what amounted to a gardening school, which awarded him a correspondence degree.⁷ The only training he had in

crop breeding was a brief course in cultivating sugar beets.⁸ In 1925, he landed a middle-level job at the Gandzha Plant Breeding Laboratory in Azerbaijan, where he worked on sowing peas. Lysenko convinced a *Pravda* reporter⁹ who was writing a puff piece about the wonders of peasant scientists¹⁰ that the yield from his pea crop was far above average, and that his technique could help feed his starving country. The glowing article the reporter wrote claimed “the barefoot professor Lysenko has followers . . . and the luminaries of agronomy visit . . . and gratefully shake his hand.”¹¹ The article was pure fiction. But it propelled Lysenko to national attention, including that of Josef Stalin.

Lysenko claimed to have conducted a set of experiments in which grain crops, including wheat and barley, produced much higher yields during stretches of cold weather after their seeds were frozen in water before planting. This method, he said, could quickly double the yield of farmlands in the Soviet Union in just a few years. In truth, Lysenko never undertook any legitimate experiment on increased crop yield. Any “data” he claimed to have produced he simply fabricated.

With Stalin as his ally, he launched a crusade to discredit work in genetics, in part, because proof of the genetic theory of evolution would expose him as a fraud. He railed against geneticists, both in the West and in the Soviet Union, as subversives, to Stalin’s great pleasure. At an agricultural conference held at the Kremlin in 1935, when Lysenko finished a fire-spitting speech in which he called geneticists “saboteurs,” Stalin rose to his feet and yelled, “Bravo, Comrade Lysenko, bravo.”¹²

Though initially hoodwinked by Lysenko, over time, as he looked into Lysenko’s claims, Vavilov became suspicious of his results, and he asked a student to conduct research to see if he could replicate Lysenko’s findings. In a series of experiments conducted from 1931 to 1935, Lysenko’s claims were disproven.¹³ Having revealed that Lysenko was a fraud, Vavilov became his fearless opponent. In retaliation, in 1933 Stalin’s Central Committee forbade Vavilov from any more travels abroad and he was publically denounced in *Pravda*, the government’s mouthpiece. Lysenko warned Vavilov and his stu-

dent that “when such erroneous data were swept away . . . those who failed to understand the implications” would also be “swept away.”¹⁴ Vavilov was undeterred and kept up his fight against Lysenko, and in 1939 at a meeting of the All-Union Institute of Plant Breeding he gave a talk in which he declared, “We shall go into the pyre, we shall burn, but we shall not retreat from our convictions.”¹⁵ Shortly later, in 1940, while traveling in the Ukraine, he was picked up by four men wearing dark suits and thrown into prison in Moscow. Then, the man who had collected 250,000 domesticated plant samples, had cheated death repeatedly, and had worked to solve the puzzle of famine in his homeland was slowly starved to death over the course of three years.

Dmitri had devoured Vavilov’s work. He admired both the scope of Vavilov’s accomplishments and his defiant defense of genetics. He hoped that the fox domestication project would help keep Vavilov’s example of innovation and fortitude alive, and he expected Vavilov would have heartily approved.

Dmitri knew that his brother Nicholai would also have been an enthusiastic proponent of the fox domestication experiment, despite his own tragic fate at the hands of Lysenko. The Belyaev family had suffered many blows in the waves of brutal crackdowns that followed the 1917 revolution, but they had stayed true throughout to their convictions.

Dmitri’s father, Konstantin, had been a parish priest in the village of Protasovo, with a population of only several hundred, situated in a picturesque landscape of wide meadows and lush forests a four-hour drive south of Moscow. By all accounts, the villagers adored him. The Russian authorities did not. Soon after the 1917 revolution, the government declared the state to be atheist. It cracked down hard on religion, confiscating church property and harassing believers. Dmitri’s father was imprisoned repeatedly.

By 1927, when Dmitri was ten, the harassment of the clergy had so intensified that his parents were worried for his safety. They sent him away from his hometown of Protasovo to live with Nikolai, who was eighteen years his senior and was married and living in Moscow.

Nikolai had been lucky enough to enter Moscow State University before the suppression of religion would have barred him, as the son of a priest. He majored in the new field of genetics, conducting work on butterflies.

Dmitri idolized Nikolai and, whenever Nikolai was home from college, would help him catalog butterfly specimens, while Nikolai explained how these delicate creatures might help geneticists unravel such wonders as metamorphosis. When Dmitri moved in with his brother, Nikolai was studying at the Koltsov Institute of Experimental Biology and working in the laboratory of Sergei Chetverikov, one of the country's most respected and well-known geneticists.¹⁶ Chetverikov's lab was producing many of the country's finest scientists, and Nikolai had become a favored protégé, seen by many in the research community as one of the leaders of the next era of Russian genetics. Each Wednesday the members of the Chetverikov lab would meet for tea and discuss the most recent findings. Nikolai took Dmitri to many of these meetings. The younger brother would sit in the back, fascinated by the unbridled passion of the debates, which featured a great deal of yelling, leading Dmitri to refer to them as the "yelling meetings."

Nikolai Belyaev's reputation continued to rise, and in 1928 he was offered a job at the Mid-Asian Institute of Silk Study in Tashkent, Uzbekistan, where he moved to research silkworm genetics. This was a prime appointment, as any improvement in the production of silk might prove a boon for the Soviet industry. Dmitri had hopes of following in his brother's academic path, but he was sent next to live with his older sister Olga and her family in Moscow. Because they were struggling to make ends meet for their two children, Dmitri was enrolled in a seven-year vocational program, in which he trained to be an electrician.¹⁷ He hoped he might still pursue a university education, but when he tried to apply for admission to Moscow State University at age seventeen, he received a rude awakening. The university was no longer admitting the sons of priests. Dmitri was forced to attend a trade college instead, enrolling at Ivanova State Agricultural Academy. At least he could study biology at the

agricultural school, and many top-notch scientists visited there to give lectures on the newest advances in genetics.

In the winter of 1937, Dmitri's family received the news that Nikolai had disappeared. His research on silkworm genetics had produced important results, and he'd been appointed head of a government-funded institute in Tbilisi. During a trip to Moscow to visit family and friends in the fall of 1937, Nikolai was warned that arrests of his geneticist colleagues had begun in Tbilisi. In spite of the danger, he went back for his wife and twelve-year-old son. Only many years later did the family finally learn that soon after he returned, he and his wife were arrested. On November 10, 1937, Nikolai was executed.¹⁸ His mother searched for Nikolai's wife for years, and finally learned that she had been sent to a prison near the city of Baysk, but she could never make contact with her or find news of what had happened to her grandson.

Nikolai's disappearance and murder fueled Dmitri's commitment to repudiating Lysenko. He knew he had to take measured steps, and while he was finishing his college degree, one of his professors had become the head of a section of the Central Research Laboratory on Fur Breeding Animals in Moscow. Upon Dmitri's graduation in 1939 the professor secured Dmitri a job there as a senior lab technician, working to breed silver foxes with beautiful fur, for sale overseas. Less than a year later, World War II had broken out. Because Dmitri had distinguished himself in service, sustaining multiple life-threatening injuries in four years of intense fighting on the front, the army was reluctant to decommission him at war's end. But his fox breeding work was deemed so important by the Minister of Foreign Trade that he was released from service to rejoin the laboratory and he was eventually appointed head of the Department of Selection and Breeding. Due to the stellar reputation he had rapidly developed for the excellence of his breeding work, Dmitri felt confident that he could begin openly speaking out against Lysenko, and he did so vigorously.

In July 1948, as part of Stalin's anti-intellectualism and anti-cosmopolitanism program, a grand plan to "transform nature" was

put into place by the Soviet government and Lysenko was placed in charge of all policy regarding the biological sciences.¹⁹ Shortly thereafter, at the August 1948 meeting of the All-Union Lenin Academy of Agricultural Sciences, Lysenko presented a talk that is widely regarded as the most disingenuous and dangerous speech in the history of Soviet science, titled “The Situation in the Science of Biology,” in which he once again railed against “modern reactionary genetics,”²⁰ by which he meant modern Western genetics. At the end of his ranting, the audience stood and cheered wildly.²¹

Geneticists at the meeting were forced to stand up and refute their scientific knowledge and practices. Those who refused were ejected from the Communist Party and lost their jobs.²² Reading the news of the speech, Dmitri was both distraught and furious. Belyaev’s wife, Svetlana, remembers the moment her husband approached her the next day at home, having just read in the newspaper about the meeting, recounting, “Dmitri was walking toward me with tough sorrowful eyes, restlessly bending and bending the newspaper in his hands.”²³ A colleague recalls running into him that day and how Dmitri had fumed that Lysenko was “a scientific bandit.” Belyaev began speaking out urgently about the evils of Lysenkoism to all fellow scientists, whether friend or foe.

Though protected from being fired by the importance of his fur breeding work, Dmitri was not entirely immune to Lysenko’s influence. A cartoon in a Moscow magazine lampooned him, depicting him descending from the sky in a parachute with the caption “Come down to Earth,” and a group of Moscow scientists sympathetic to Lysenko organized a meeting in which they lambasted the reactionary geneticists “guided by Belyaev.” Dmitri appeared at the meeting and made a defiant, impassioned speech about the importance of continuing genetic research. As a result, he was banned from teaching at the Moscow Fur Institute, and the scientific papers he submitted to journals were instantly rejected. His laboratory pay was cut in half, his staff was reassigned, and he was demoted from department head to senior scientist.

Belyaev had nonetheless managed to continue to investigate ge-

netics through his work with minks and foxes. And some of this work gave him hope that it might just be possible that the pilot experiment Nina Sorokina was running would produce significant results in shorter time than a classic interpretation of Darwin's theory of evolution would suggest. He had an idea about why so many different changes in animals—floppy ears, curly tails, and spots, the breaking of the once-a-year mating rule—came along with the process of domestication, and why they might emerge relatively quickly. He hadn't shared this with Nina Sorokina when he visited in 1952; the idea was too provisional to share with anyone yet, especially because it cut against the grain of the prevailing wisdom about the nature of evolutionary change.

Darwin had argued that evolutionary change would usually occur in small incremental steps, and that changes of the kind associated with the dramatic modifications seen in domesticated animals would take eons to accumulate. But Belyaev had noted that with the minks brought in from the wild for the breeding program, which had begun less than thirty years earlier, striking changes in the colors of their fur had emerged in just that short time. Minks in the wild have dark brown fur. But suddenly some minks had been born with beige, silvery-blue, and white fur. And this seemed to happen over and over, much more often than any geneticist could attribute to new mutations. Belyaev thought this must mean that the wild mink possessed the genes for producing these fur colors already in their genomes, but that those genes had been what he called inactive. He proposed that the change in their environment, being brought into captivity, and the new selection pressure of being bred for fur quality must have triggered these "dormant" genes to become active.

With the foxes, he had seen that white patches that had once appeared on the feet of some foxes and then stopped showing up had suddenly reappeared in later generations, but now on the faces of some foxes. Some geneticists had suggested that genes that were inactive could be "turned on" in some way, and also that genes might for some reason start producing different effects, like the change in

the location of the white patches in the foxes. Dmitri thought these kinds of changes in gene activation were behind the many changes in domestication. This suggested to him that domestication could perhaps occur much more rapidly than the standard interpretation of Darwin's theory implied.

Belyaev hoped that his fox experiment might produce such rapid change. But, then again, he could be wrong and it might produce no notable results at all. That was science. He'd come up with an idea too intriguing not to pursue, he'd set the test in motion, and now all he could do was wait for some word from Nina.