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Lee A. Dugatkin
University of Louisville

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LEE ALAN DUGATKIN

HOW TO BUILD A DOMESTICATED FOX: THE START OF A LONG JOURNEY

In 1959, outside of Novosibirsk, Siberia, Dmitri Belyaev and Lyudmila Trut began what remains one of the longest-running experiments in biology. For the last 59 years they have been domesticating silver foxes and studying evolution in real time. Belyaev died in 1985, but Trut has continued to lead this experiment up to this very day. Each generation they and their team have been selecting the calmest, most prosocial-toward-humans foxes and preferentially breeding those individuals. Today they have foxes that are calmer than lap dogs, and who also *look* eerily dog-like—floppy ears, wagging tail and all. Belyaev and Trut’s results have fundamentally changed how we think of the process of domestication: to enumerate all their findings and discuss their importance would require a book, which is why Lyudmila Trut (now 84 years old) and I wrote *How to Tame a Fox (and Build a Dog)* (University of Chicago Press, 2017).



Figure 1: A domesticated fox pup today

Here, I want to take you back to the earliest days of the experiment, when some of the amazing transformations that would come to symbolize this experiment were only first emerging. To do that we need to join Trut, just three years out of her undergraduate days at Moscow State University, and her mentor Belyaev, with his mesmerizing blue eyes, on a train ride that they took from Novosibirsk, Siberia to Moscow in December 1961.

Like all December days in Siberia, the temperature was in negative double digits and dropping. The twenty-three-hundred-mile ride on the Trans-Siberian railway from Novosibirsk to Moscow would take two days and two nights. In the early years of the silver fox domestication experiment, there were many long train rides like this one, across the Soviet Union. With the brainpower and creative forces of the silver fox experiment residing at The Institute of Cytology and Genetics—a center that had literally been carved out of the forests around Novosibirsk—and the early experiments taking place in the Altay region of Siberia, some nine hundred miles away, there had been a lot of travel on the rails.

They were an unusual team stepping onto the train known as “The Sibiryak” that winter day in 1961. There was forty-four-year-old Belyaev, renowned scientist, director of The Institute of Cytology and Genetics and a key player in the Siberian Branch of the Soviet Academy of Sciences: “a true man, where dignity meets handsome” was the way one of his female assistants described him. He had a gentle face and piercing eyes, but he also emanated the sense of an individual who had seen the horrors of war up close and lived to tell about them. Twenty-seven-year-old Lyudmila Trut had been working with Belyaev for all three years of her professional life in science. Petite, she could be quiet or outspoken, depending on what the situation called for. Belyaev had conceived of the silver fox work, and remained fundamental to the project at every step along the way, but Lyudmila was doing the day-to-day work with the foxes and had already proven, through grueling travel and endless days of fieldwork, that she was not only brilliant and creative, but could also be as tough as nails.

This particular two-night train ride to Moscow was set in motion to gather key information about experimental protocol, rather than the foxes themselves. Belyaev and

Trut were heading to a national seminar on animal breeding. The fox experiment involved breeding dozens of foxes, and it would soon require hundreds of these animals, so practical issues about animal breeding were something the team always wanted to learn more about. The two days and nights on the train to Moscow seemed worth the time and effort. And unlike other research scientists of the day, Belyaev did not look down on animal breeders as some sort of second-class scientists—he himself had worked in that field for many years. He understood that he and Lyudmila could learn much from spending some time with breeders. On that train ride “he talked a lot,” Lyudmila recalls, “about how in any scientific or practical field the most important part is people.”

Not long after the Sibiryak departed from the Novosibirsk railway station, it traversed a huge bridge that spanned the frozen Ob River. The seventh longest river in the world, flowing north and west for 3362 miles, and a major transportation artery, the Ob River has willow trees, snowball trees, currents and wild roses growing along its banks; sturgeon, white fish, carp, perch, river otters and minks swimming in its water; and some 170 different species, including grouse, partridge, geese and ducks forming breeding grounds along its floodplains. Of course, most of the action along the riverbanks and in the water occurred during the warmer parts of the year, but the beauty of the windswept snow, hanging almost like a frozen mist over the ice-covered Ob was not lost on the two scientists. “We were standing by a window of a long hall,” Trut recalled. “Belyaev was thinking out loud how huge Russia is and how beautiful and magnificent its nature. He was telling me that we should travel more often so that we can see and appreciate as much as possible.”

The Trans-Siberian railroad runs for more than 5000 miles and in 1961 it was *the* artery that connected Siberia to the rest of the Soviet Union. The easternmost station on the railroad is the giant port city of Vladivostok, sitting on the Golden Horn Bay, not all that far from China. During the cold war, this city housed Russia’s Pacific Fleet, and security there was tight. The westernmost terminal on the Trans-Siberian railway was one of cosmopolitan centers of the country, and Belyaev and Trut’s destination—Moscow.

Traveling almost due west from Novosibirsk to Moscow, the Sibiryak made 14 stops along the way, including large cities like Omsk, Tyumen, Chelyabinsk, Ufa and

Yaroslavi. Passengers came and went, with fifteen or twenty departing, and about the same amount boarding, at each stop as the train trekked west. Both Trut and Belyaev were very familiar with the route, as they had traversed it, or sections of it, either as a team or alone many, many times.

The Sibiryak had about fifteen cars, and each car had nine passenger compartments. Most cars had compartments that slept four, but because Belyaev was already a highly respected scientist and an Akademician (a member of The Soviet Academy of Sciences), he and Lyudmila were put in a special car that had two-person, rather than four-person, sleeping compartments. Reserved for high-ranking passengers, this car was especially quiet and well heated. “In the mornings and evenings, “Lyudmila recalls, “the service lady brought tea to the compartments. In each compartment there was a speaker, so, if desired, we could turn it on and listen to news or music.”

These trips gave Dmitri and Lyudmila a chance to get to know each other better. “We talked about what constituted our lives,” says Lyudmila “His youngest son, Misha, and my daughter, Mariana, have the same birthday, December 29. We talked about them, how they were growing, what they said and did. We also talked about our mothers, who lived with us.” They also talked about their hobbies: “He liked very much the Russian writer Leskov,” Lyudmila recalled, “and when he found out that I hadn’t read *The Amazon* and *The Enchanted Wanderer*, he said that I should read them as soon as possible.” When quarters got too close, which was inevitable when two people travel together on a train for 48 straight hours, social interactions with others were readily available in the hall outside the sleeping compartments or at stops along the route. Dress in the train car was casual, as people slept in what they wore. Only when the train would stop at a large city, and there was time to pop off for a bit, did people put on their dress clothes.

“At night Belyaev slept very little,” Trut recalled. “He was reading a lot—on the other hand I wanted to sleep.” With a young child at home, and a full time career as a scientist, sleep was a valuable commodity for Lyudmila. As the train chugged along to Moscow, Belyaev sat in the small railroad car reading and occasionally nodding off, perhaps dreaming of his younger days in Moscow with his brother Nikolai.

The Sibiryak train had a restaurant car, but Belyaev's wife, Svetlana Argutinskaya, would do what she could to keep her husband and her friend Lyudmila out of that car for at least the first half of the trip. Svetlana, herself a well-respected biologist, prepared pierogi, cooked beef, hard boiled eggs, hard salami and vegetables for the team to take with them to Moscow. The home-cooked food was much appreciated and savored while it lasted, but by the second day it was gone, and so Belyaev and Trut would eat in the restaurant car or grab something there and bring it back to their compartment. On occasion they would pick up hot boiled potatoes and pickles from local women who would be waiting at the depot when the Sibiryak stopped in a major city.

The stops also provided a chance to get some fresh air and to stretch. And Belyaev thoroughly enjoyed meeting with and talking with the locals peddling food. He had a way of connecting to people, regardless of their social status, and people seemed to be innately drawn towards him, sensing a genuinely kind and caring man. It is not impossible that his foxes sensed the very same thing.

The causal, comfortable environment of the Sibiryak train car was the perfect backdrop for Belyaev and Trut to discuss and mull over their early work on the fox domestication experiment. Lyudmila recalls that shop talk included inspirational reminders from Belyaev—"He was telling me back then that the experiment will be very long, maybe as long as my life, encouraging me to be patient," but "most of our time during that travel we discussed data that I collected."

Preliminary data on changes to the foxes' behavior was encouraging, Lyudmila told him, as she had gathered evidence suggesting a genetic underpinning to "calmness," a big first step in the process of domestication and a linchpin in Belyaev's hypothesis of how domestication unfolded in real time. There were even a few foxes, like Laska ("Gentle"), that allowed Lyudmila to pick them up and hold them in her arms (Figures 2 and 3).



Figure 2. Lyudmila and Laska, circa 1961. Figure 3. Lyudmila Trut with one of the domesticated foxes today.

Belyaev was also interested in the way that domesticated animals had very different reproductive cycles than their ancestors in the wild. Two things particularly fascinated him. Wild animals tend to have a fixed reproductive season—often a very short one—but their domesticated descendants often cast off that constraint and are capable of breeding during any time of the year. What’s more, it isn’t just that domesticated animals can breed any time of the year; in some cases, they are actually reproducing more than once a year. The entire reproductive biology of animals seems reshaped by domestication. If that was happening with his foxes, it meant he was on the way to unlocking the mysteries of domestication.

Belyaev and Trut looked through the data Lyudmila had collected on whether the earliest generations of foxes in the domestication experiment had shifted from a single short reproductive period toward a longer, less constrained breeding system. It was still early in the experiment, and while they weren’t seeing definitive signs of a major shift in reproduction, there were hints in the data. Wild foxes almost always breed only from the

end of January to the end of March. Domesticated foxes were going into estrous a few days earlier than their wild foxes. There was reason for hope with respect to this one prediction about the dramatic effects of domestication.

On the final day of the trip on the *Sibiryak*, shortly before the city of Yaroslavl, the *Sibiryak* was winding its way through the residential areas of Ural, when Lyudmila “specifically remembers [seeing] the beautiful golden domes of old Russian churches in Murom... and [looking] at those places with excitement although we had seen them many times.” Murom, a city that sits on the left bank of the Oka River, traces its origin back to 862 AD. The city, Trut reminisced, “was the birthplace of my parents.” Parents who would have been very proud of their young scientist daughter, who in her everyday work had already come to adopt French explorer and writer Antoine de Saint-Exupéry’s philosophical stand that “we are responsible for those who we tame.”

The last leg of the journey on the *Sibiryak* always was special to Lyudmila Trut. “Every time when I travel to Moscow,” she would say, “I feel almost like an anxiety inside of me because for me that is where I grew up and went to school and that is the place I left to go to Siberia.” And though Belyaev was her mentor, her advisor, and seventeen years her senior, Lyudmila felt comfortable sharing her feelings with him. To her delight, Dmitri told her that he felt the very same way. He then proceeded to tell her stories of his childhood days in Moscow with his brother Nikolai and then his sister Olga, and how such memories “leave a lifetime impression in our memory.”

As the train pulled into Moscow and Belyaev and Trut disembarked to head for the animal breeders’ meetings, Dmitri had high hopes for the domestication work. It appeared that calmness in his foxes was linked to their genetic makeup. The workers involved with the fox experiment seemed to love what they were doing, always going far beyond the call of duty, forging deep bonds with their experimental subjects. And the speed at which his and Lyudmila’s foxes were evolving, corresponding with massive changes to their behavior, anatomy and physiology, would soon come to make Belyaev and Trut understand just how revolutionary their experiment really was.