The Invention of Nature

Alexander von Humboldt's New World

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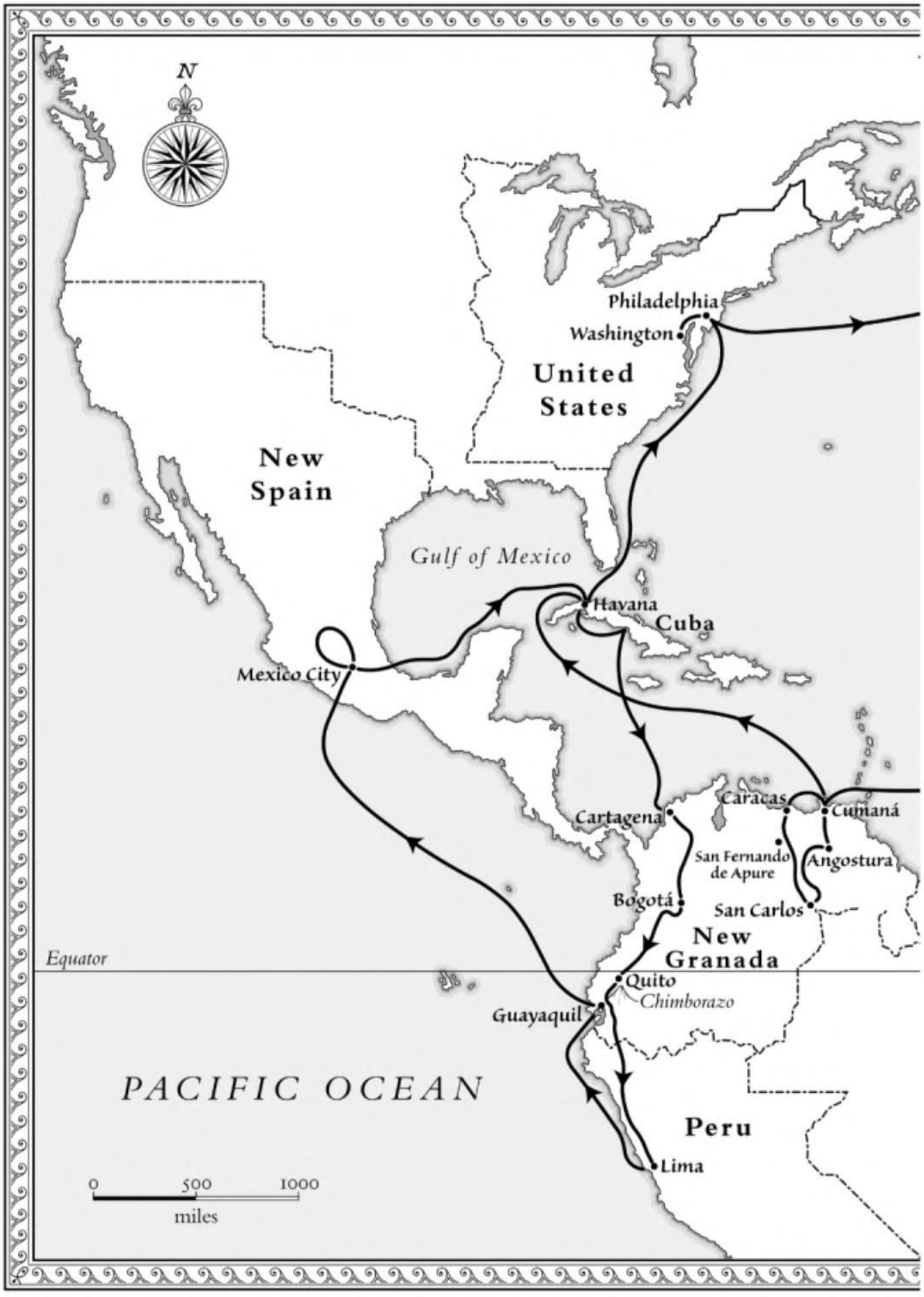

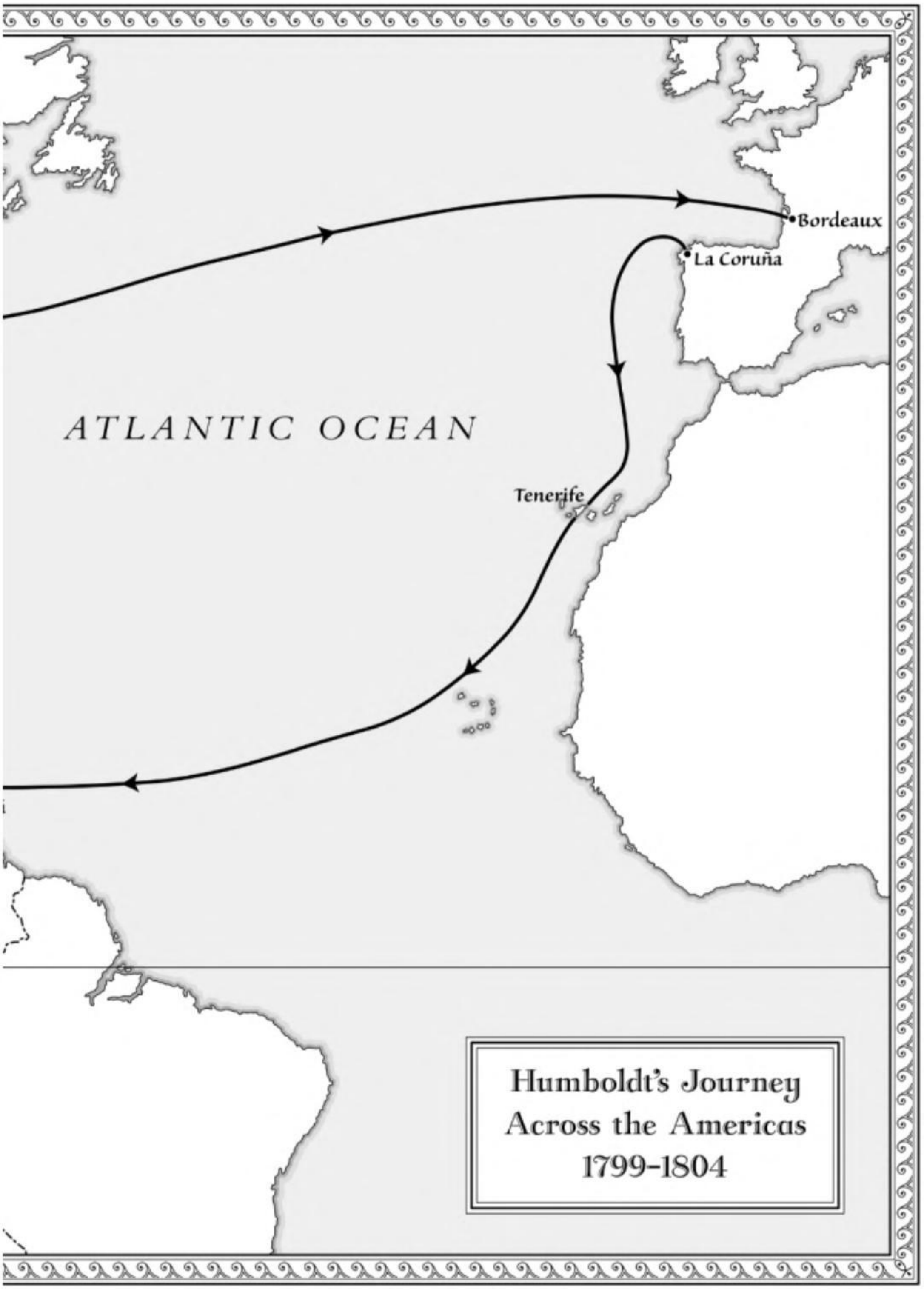

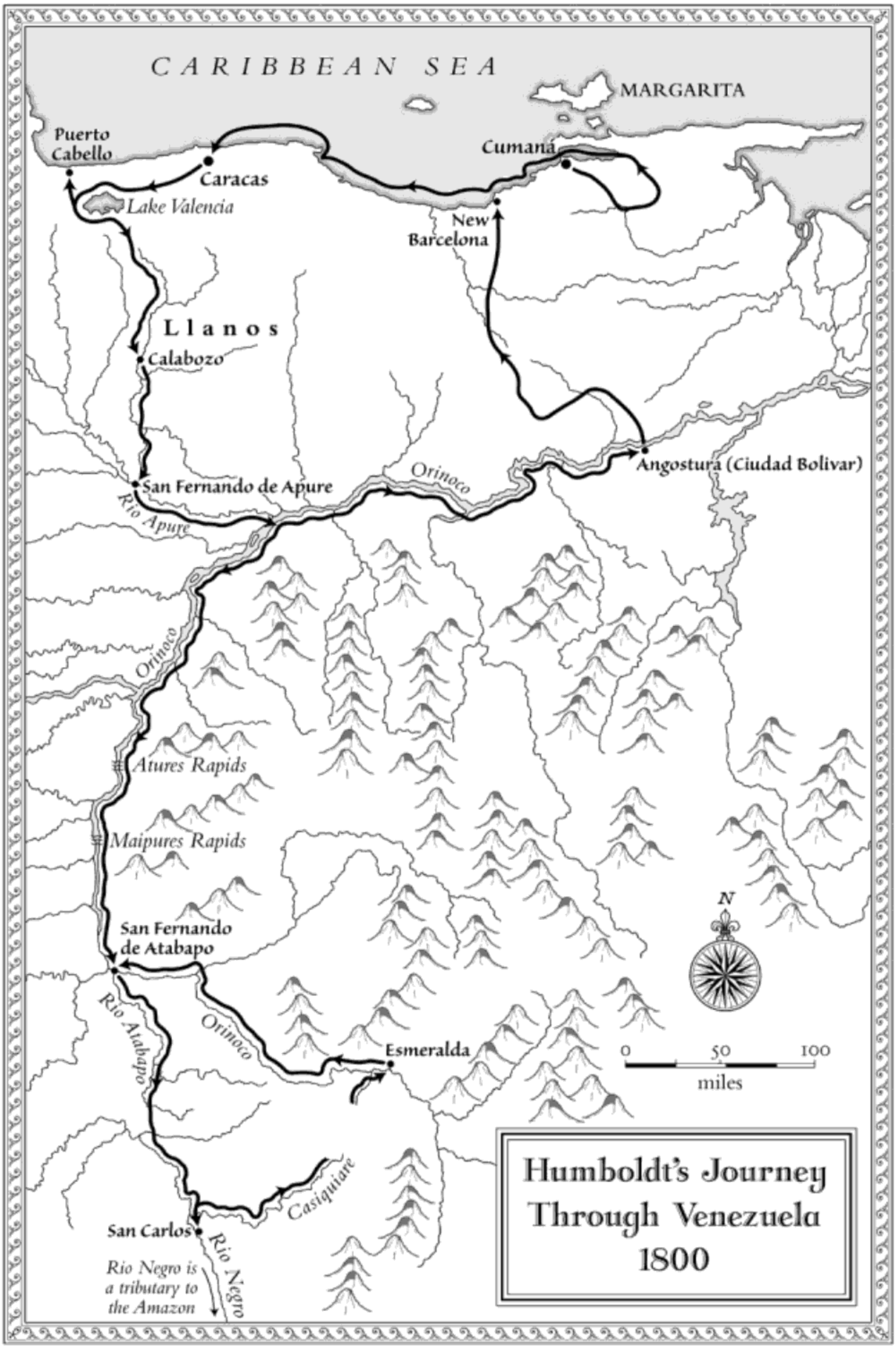

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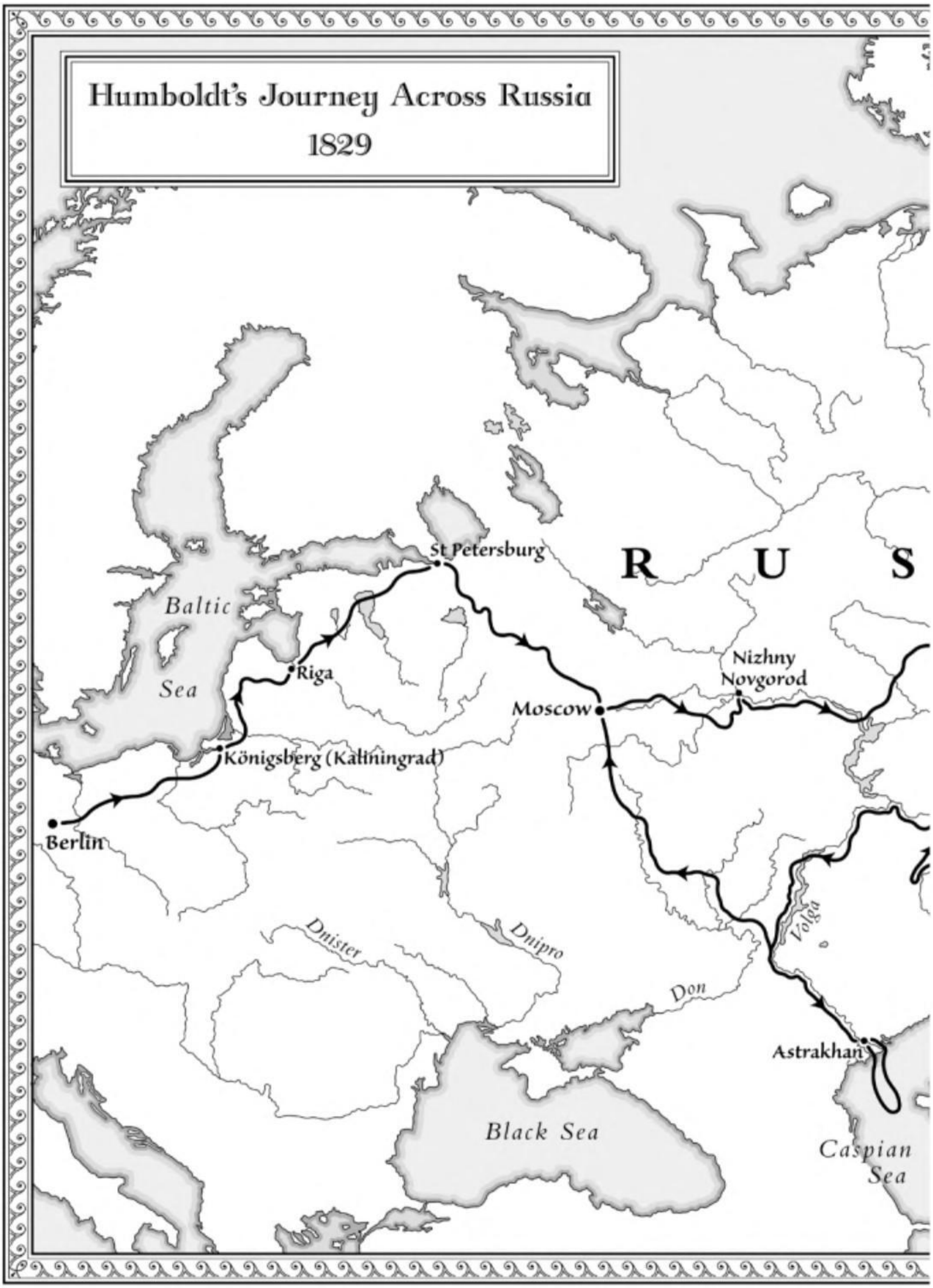
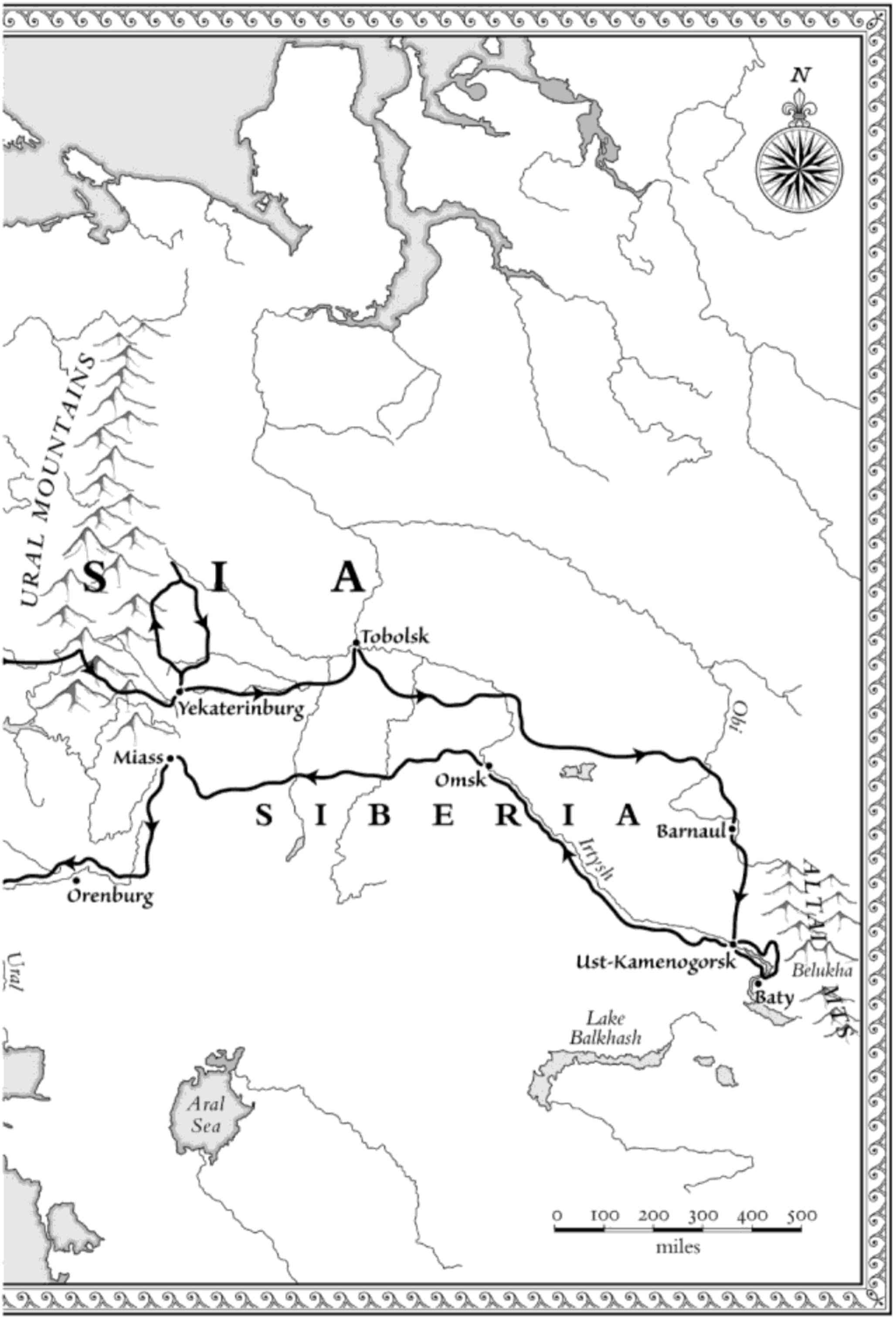




Author's Note

Alexander von Humboldt's books have been published in many languages. When quoting from his books directly, I have compared the original German (where applicable) and contemporary English editions. Where newer English editions have been available, I have checked those against the older translations and where I felt that the newer edition provided a better translation, I have chosen that version (details are in the endnotes). Sometimes neither translation captured Humboldt's prose, or whole sentences were missing – in which case I have taken the liberty of providing a new translation. When other protagonists referred to Humboldt's work, I have used the editions that they were reading. Charles Darwin, for example, read Humboldt's *Personal Narrative* that was published in Britain between 1814 and 1829 (translated by Helen Maria Williams), while John Muir read the 1896 edition (translated by E.C. Otte and H.G. Bohn).

Prologue

They were crawling on hands and knees along a high narrow ridge that was in places only two inches wide. The path, if you could call it that, was layered with sand and loose stones that shifted whenever touched. Down to the left was a steep cliff encrusted with ice that glinted when the sun broke through the thick clouds. The view to the right, with a 1,000-foot drop, wasn't much better. Here the dark, almost perpendicular walls were covered with rocks that protruded like knife blades.

Alexander von Humboldt and his three companions moved in single file, slowly inching forward. Without proper equipment or appropriate clothes, this was a dangerous climb. The icy wind had numbed their hands and feet, melted snow had soaked their thin shoes and ice crystals clung to their hair and beards. At 17,000 feet above sea level, they struggled to breathe in the thin air. As they proceeded, the jagged rocks shredded the soles of their shoes, and their feet began to bleed.

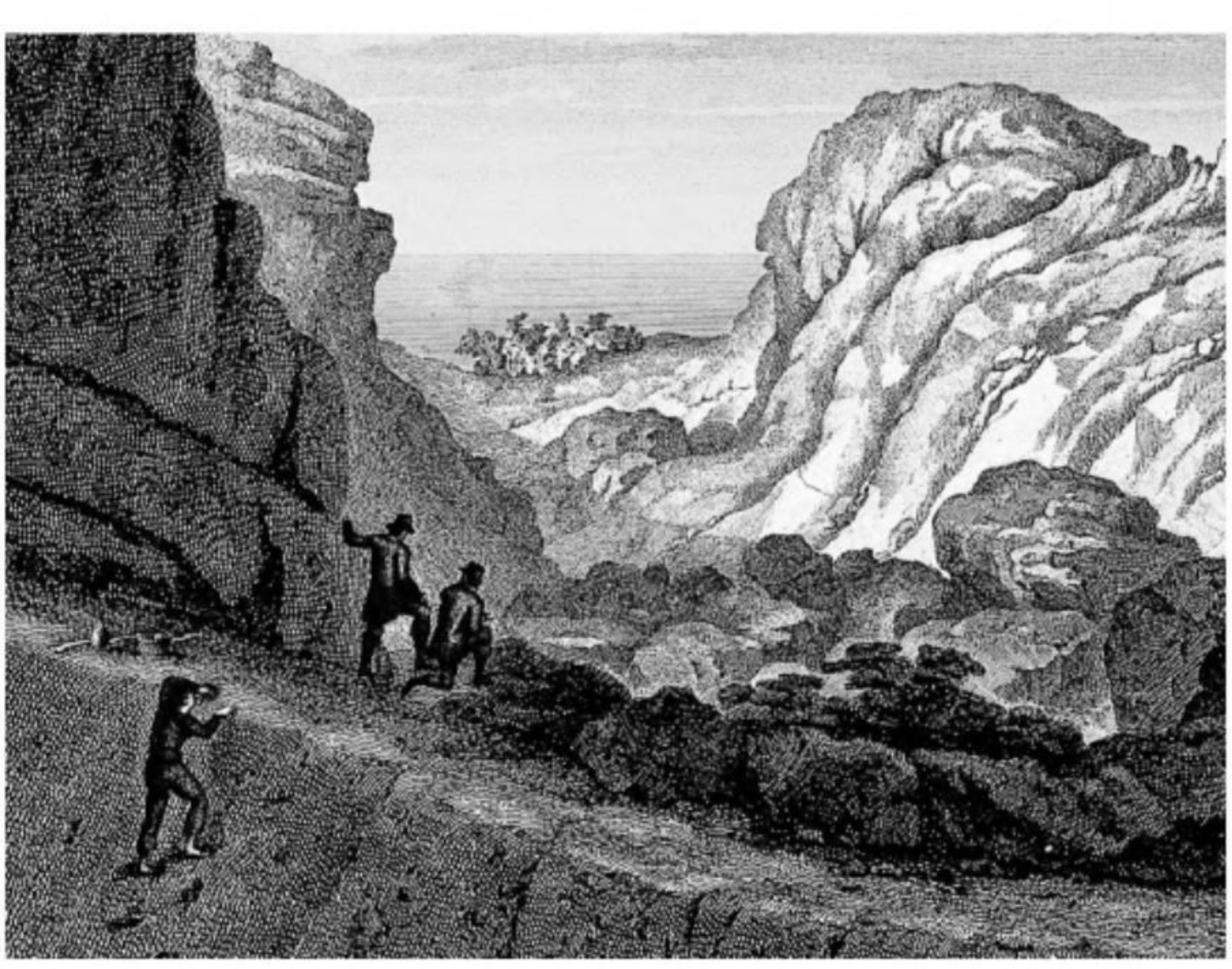
It was 23 June 1802, and they were climbing Chimborazo, a beautiful dome-shaped inactive volcano in the Andes that rose to almost 21,000 feet, some 100 miles to the south of Quito in today's Ecuador. Chimborazo was then believed to be the highest mountain in the world. No wonder that their terrified porters had abandoned them at the snow line. The volcano's peak was shrouded in thick fog but Humboldt had nonetheless pressed on.

For the previous three years, Alexander von Humboldt had been travelling through Latin America, penetrating deep into lands where few Europeans had ever gone before. Obsessed with scientific observation, the thirty-two-year-old had brought a vast array of the best instruments from Europe. For the ascent of Chimborazo, he had left most of the baggage behind, but had packed a barometer, a thermometer, a sextant, an artificial horizon and a so-called 'cyanometer' with which he could measure the 'blueness' of the sky. As they climbed, Humboldt fumbled out his instruments with numb fingers, setting them upon precariously narrow ledges to measure altitude, gravity and humidity. He meticulously

listed any species encountered – here a butterfly, there a tiny flower. Everything was recorded in his notebook.

At 18,000 feet they saw a last scrap of lichen clinging to a boulder. After that all signs of organic life disappeared, because at that height there were no plants or insects. Even the condors that had accompanied their previous climbs were absent. As the fog whitewashed the air into an eerie empty space, Humboldt felt completely removed from the inhabited world. 'It was,' he said, 'as if we were trapped inside an air balloon.' Then, suddenly, the fog lifted, revealing Chimborazo's snow-capped summit against the blue sky. A 'magnificent sight', was Humboldt's first thought, but then he saw the huge crevasse in front of them – 65 feet wide and about 600 feet deep. But there was no other way to the top. When Humboldt measured their altitude at 19,413 feet, he discovered that they were barely 1,000 feet below the peak.

No one had ever come this high before, and no one had ever breathed such thin air. As he stood at the top of the world, looking down upon the mountain ranges folded beneath him, Humboldt began to see the world differently. He saw the earth as one great living organism where everything was connected, conceiving a bold new vision of nature that still influences the way that we understand the natural world.



Humboldt and his team climbing a volcano

Described by his contemporaries as the most famous man in the world after Napoleon, Humboldt was one of the most captivating and inspiring men of his time. Born in 1769 into a wealthy Prussian aristocratic family, he discarded a life of privilege to discover for himself how the world worked. As a young man he set out on a five-year exploration to Latin America, risking his life many times and returning with a new sense of the world. It was a journey that shaped his life and thinking, and that made him legendary across the globe. He lived in cities such as Paris and Berlin, but was equally at home on the most remote branches of the Orinoco River or in the Kazakh Steppe at Russia's Mongolian border. During much of his long life, he was the nexus of the scientific world, writing some 50,000 letters and receiving at least double that number. Knowledge, Humboldt believed, had to be shared, exchanged and made available to everybody.

He was also a man of contradictions. He was a fierce critic of colonialism and supported the revolutions in Latin America, yet was chamberlain to two Prussian kings. He admired the United States for their concepts of liberty and equality but never stopped criticizing their failure to abolish slavery. He called himself 'half an American', but at the same time compared America to 'a Cartesian vortex, carrying away and levelling everything to dull monotony'. He was confident, yet constantly yearned for approval. He was admired for his breadth of knowledge but also feared for his sharp tongue. Humboldt's books were published in a dozen languages and were so popular that people bribed booksellers to be the first to receive copies, yet he died a poor man. He could be vain, but would also give his last money to a struggling young scientist. He packed his life with travels and incessant work. He always wanted to experience something new and, as he said, ideally, 'three things at the same time'.

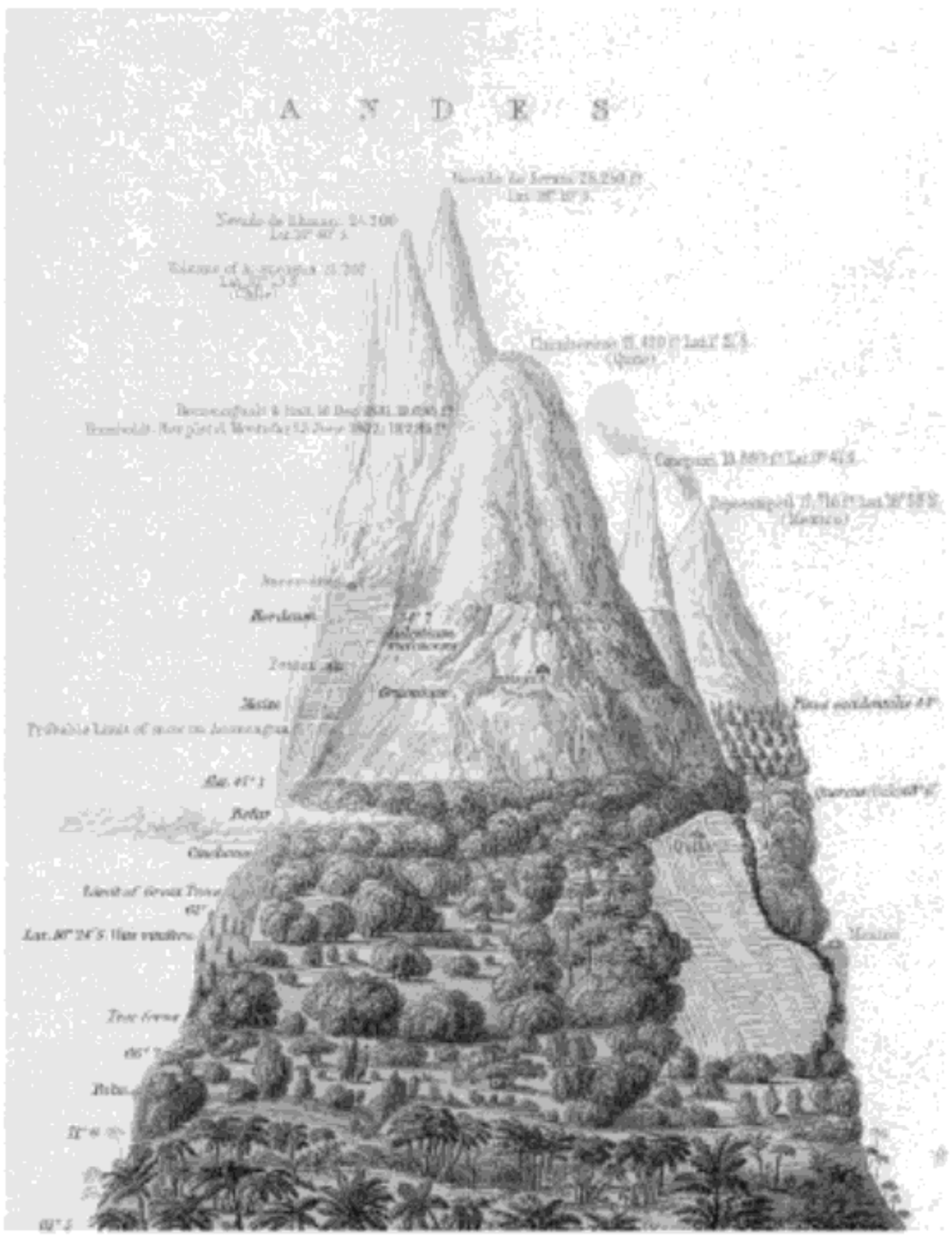
Humboldt was celebrated for his knowledge and scientific thinking, yet he was no cerebral scholar. Not content in his study or among books, he threw himself into physical exertion, pushing his body to its limits. He ventured deep into the mysterious world of the rainforest in Venezuela and crawled along narrow rock ledges at a precarious height in the Andes to see the flames inside an active volcano. Even as a sixty-year-old, he travelled more than 10,000 miles to the remotest corners of Russia, outpacing his younger companions.

Fascinated by scientific instruments, measurements and observations, he was driven by a sense of wonder as well. Of course nature had to be measured and analysed, but he also believed that a great part of our response to the natural world should be based on the senses and emotions.

He wanted to excite a 'love of nature'. At a time when other scientists were searching for universal laws, Humboldt wrote that nature had to be experienced through feelings.

Humboldt was unlike anybody else because he was able to remember even the smallest details for years: the shape of a leaf, the colour of soil, a temperature reading, the layering of a rock. This extraordinary memory allowed him to compare the observations he had made all over the world several decades or thousands of miles apart. Humboldt was able to 'run through the chain of all phenomena in the world at the same time', one colleague later said. Where others had to ransack their memories, Humboldt – 'whose eyes are natural telescopes & microscopes' as the American writer and poet Ralph Waldo Emerson said in admiration – had every morsel of knowledge and observation to hand at an instant.

As he stood on Chimborazo, exhausted by the climb, Humboldt absorbed the view. Here vegetation zones were stacked one on top of the other. In the valleys, he had passed through palms and humid bamboo forests where colourful orchids clung to the trees. Further up he had seen conifers, oaks, alders and shrub-like berberis similar to those he knew from European forests. Then had come alpine plants much like



The distribution of plants in the Andes

those he had collected in the mountains in Switzerland and lichens that reminded him of specimens from the Arctic Circle and Lapland. No one had looked at plants like this before. Humboldt saw them not through the narrow categories of classification but as types according to their location and climate. Here was a man who viewed nature as a global force with corresponding climate zones across continents: a radical concept at the time, and one that still colours our understanding of ecosystems.

Humboldt's books, diaries and letters reveal a visionary, a thinker far ahead of his time. He invented isotherms – the lines of temperature and pressure that we see on today's weather maps – and he also discovered the magnetic equator. He came up with the idea of vegetation and climate zones that snake across the globe. Most important, though, Humboldt revolutionized the way we see the natural world. He found connections everywhere. Nothing, not even the tiniest organism, was looked at on its own. 'In this great chain of causes and effects,' Humboldt said, 'no single fact can be considered in isolation.' With this insight, he invented the web of life, the concept of nature as we know it today.

When nature is perceived as a web, its vulnerability also becomes obvious. Everything hangs together. If one thread is pulled, the whole tapestry may unravel. After he saw the devastating environmental effects of colonial plantations at Lake Valencia in Venezuela in 1800, Humboldt became the first scientist to talk about harmful human-induced climate change. Deforestation there had made the land barren, water levels of the lake were falling and with the disappearance of brushwood torrential rains had washed away the soils on the surrounding mountain slopes. Humboldt was the first to explain the forest's ability to enrich the atmosphere with moisture and its cooling effect, as well as its importance for water retention and protection against soil erosion. He warned that humans were meddling with the climate and that this could have an unforeseeable impact on 'future generations'.

The Invention of Nature traces the invisible threads that connect us to this extraordinary man. Humboldt influenced many of the greatest thinkers, artists and scientists of his day. Thomas Jefferson called him 'one of the greatest ornaments of the age'. Charles Darwin wrote that 'nothing ever stimulated my zeal so much as reading Humboldt's Personal Narrative,' saying that he would not have boarded the *Beagle*, nor conceived of the *Origin of Species*, without Humboldt. William Wordsworth and Samuel Taylor Coleridge both incorporated Humboldt's concept of nature into their poems. And America's most revered nature writer, Henry David Thoreau, found in Humboldt's books an answer to his dilemma

on how to be a poet *and* a naturalist – *Walden* would have been a very different book without Humboldt. Simón Bolívar, the revolutionary who liberated South America from Spanish colonial rule, called Humboldt the 'discoverer of the New World' and Johann Wolfgang von Goethe, Germany's greatest poet, declared that spending a few days with Humboldt was like 'having lived several years'.

On 14 September 1869, one hundred years after his birth, Alexander von Humboldt's centennial was celebrated across the world. There were parties in Europe, Africa and Australia as well as the Americas. In Melbourne and Adelaide people came together to listen to speeches in honour of Humboldt, as did groups in Buenos Aires and Mexico City. There were festivities in Moscow where Humboldt was called the 'Shakespeare of sciences', and in Alexandria in Egypt where guests partied under a sky illuminated with fireworks. The greatest commemorations were in the United States, where from San Francisco to Philadelphia, and from Chicago to Charleston, the nation saw street parades, sumptuous dinners and concerts. In Cleveland some 8,000 people took to the streets and in Syracuse another 15,000 joined a march that was more than a mile long. President Ulysses Grant attended the Humboldt celebrations in Pittsburgh together with 10,000 revellers who brought the city to a standstill.

In New York City the cobbled streets were lined with flags. City Hall was veiled in banners, and entire houses had vanished behind huge posters bearing Humboldt's face. Even the ships sailing by, out on the Hudson River, were garlanded in colourful bunting. In the morning thousands of people followed ten music bands, marching from the Bowery and along Broadway to Central Park to honour a man 'whose fame no nation can claim' as the *New York Times*'s front page reported. By early afternoon, 25,000 onlookers had assembled in Central Park to listen to the speeches as a large bronze bust of Humboldt was unveiled. In the evening as darkness settled, a torchlight procession of 15,000 people set out along the streets, walking beneath colourful Chinese lanterns.

Let us imagine him, one speaker said, 'as standing on the Andes' with his mind soaring above all. Every speech across the world emphasized that Humboldt had seen an 'inner correlation' between all aspects of nature. In Boston, Emerson told the city's grandees that Humboldt was 'one of those wonders of the world'. His fame, the *Daily News* in London reported, was 'in some sort bound up with the universe itself'. In Germany there were festivities in Cologne, Hamburg, Dresden, Frankfurt and many other cities. The greatest German celebrations were

in Berlin, Humboldt's hometown, where despite torrential rain 80,000 people assembled. The authorities had ordered offices and all government agencies to close for the day. As the rain poured down and gusts chilled the air, the speeches and singing nonetheless continued for hours.

Though today almost forgotten outside academia – at least in the English-speaking world – Alexander von Humboldt's ideas still shape our thinking. And while his books collect dust in libraries, his name lingers everywhere from the Humboldt Current running along the coast of Chile and Peru to dozens of monuments, parks and mountains in Latin America including Sierra Humboldt in Mexico and Pico Humboldt in Venezuela. A town in Argentina, a river in Brazil, a geyser in Ecuador and a bay in Colombia – all are named after Humboldt.*

There are Kap Humboldt and Humboldt Glacier in Greenland, as well as mountain ranges in northern China, South Africa, New Zealand and Antarctica. There are rivers and waterfalls in Tasmania and New Zealand as well as parks in Germany and Rue Alexandre de Humboldt in Paris. In North America alone four counties, thirteen towns, mountains, bays, lakes and a river are named after him, as well as the Humboldt Redwoods State Park in California and Humboldt Parks in Chicago and Buffalo. The state of Nevada was almost called Humboldt when the Constitutional Convention debated its name in the 1860s. Almost 300 plants and more than 100 animals are named after him – including the Californian Humboldt lily (*Lilium humboldtii*), the South American Humboldt penguin (*Spheniscus humboldti*) and the fierce predatory six-foot Humboldt squid (*Dosidicus gigas*) which can be found in the Humboldt Current. Several minerals carry his name – from *Humboldtit* to *Humboldtin* – and on the moon there is an area called 'Mare Humboldtianum'. More places are named after Humboldt than anyone else.

Ecologists, environmentalists and nature writers rely on Humboldt's vision, although most do so unknowingly. Rachel Carson's *Silent Spring* is based on Humboldt's concept of interconnectedness, and scientist James Lovelock's famous Gaia theory of the earth as a living organism bears remarkable similarities. When Humboldt described the earth as 'a natural whole animated and moved by inward forces', he pre-dated Lovelock's ideas by more than 150 years. Humboldt called his book describing this new concept *Cosmos*, having initially considered (but then discarded) 'Gäa' as a title.

* To this day many German-speaking schools across Latin America hold biannual athletic competitions called *Juegos Humboldt* – Humboldt Games.

We are shaped by the past. Nicolaus Copernicus showed us our place in the universe, Isaac Newton explained the laws of nature, Thomas Jefferson gave us some of our concepts of liberty and democracy, and Charles Darwin proved that all species descend from common ancestors. These ideas define our relationship to the world.

Humboldt gave us our concept of nature itself. The irony is that Humboldt's views have become so self-evident that we have largely forgotten the man behind them. But there exists a direct line of connection through his ideas, and through the many people whom he inspired. Like a rope, Humboldt's concept of nature connects us to him.

The Invention of Nature is my attempt to find Humboldt. It has been a journey across the world that led me to archives in California, Berlin and Cambridge among many others. I read through thousands of letters but I also followed Humboldt's footsteps. I saw the ruin of the anatomy tower in Jena in Germany where Humboldt spent many weeks dissecting animals, and at 12,000 feet on the Antisana in Ecuador, with four condors circling above and surrounded by a herd of wild horses, I found the dilapidated hut where he had spent a night in March 1802.

In Quito, I held Humboldt's original Spanish passport in my hands – the very papers that allowed him to travel through Latin America. In Berlin, I finally understood how his mind worked when I opened the boxes that contained his notes – marvellous collages of thousands of bits of paper, sketches and numbers. Closer to home, at the British Library in London, I spent many weeks reading Humboldt's published books, some so huge and heavy that I could scarcely lift them on to the table. In Cambridge I looked at Darwin's own copies of Humboldt's books – those that Darwin had kept on a shelf next to his hammock on the *Beagle*. They are filled with Darwin's pencil marks. Reading these books was like eavesdropping on Darwin talking to Humboldt.

I found myself lying at night in the Venezuelan rainforest listening to the strange bellowing cry of howler monkeys, but also stuck in Manhattan without electricity during Hurricane Sandy when I had travelled there to read some documents in the New York Public Library. I admired the old manor house with its tenth-century tower in the little village of Piòbesi outside Turin where George Perkins Marsh wrote parts of *Man and Nature* in the early 1860s – a book inspired by Humboldt's ideas and one that would mark the beginning of America's conservation movement. I walked around Thoreau's Walden Pond in deep freshly fallen snow and hiked in Yosemite, reminding myself of John Muir's idea that: 'the clearest way into the Universe is through a forest wilderness'.

The most exciting moment was when I finally climbed Chimborazo, the mountain that had been so elemental to Humboldt's vision. As I walked up the barren slope, the air was so thin that every step felt like an eternity – a slow pull upward while my legs felt leaden and somehow disconnected from the rest of my body. My admiration for Humboldt grew with every step. He had climbed Chimborazo with an injured foot (and certainly not in walking boots as comfortable and sturdy as mine), loaded with instruments and constantly stopping to take measurements.

The result of this exploration through landscapes and letters, through thoughts and diaries, is this book. *The Invention of Nature* is my quest to rediscover Humboldt, and to restore him to his rightful place in the pantheon of nature and science. It's also a quest to understand why we think as we do today about the natural world.

PART I

Departure: Emerging Ideas

I

Beginnings

ALEXANDER VON HUMBOLDT was born, on 14 September 1769, into a wealthy aristocratic Prussian family who spent their winters in Berlin and their summers at the family estate of Tegel, a small castle about ten miles north-west of the city. His father, Alexander Georg von Humboldt, was an officer in the army, a chamberlain at the Prussian court and a confidant of the future king Friedrich Wilhelm II. Alexander's mother, Marie Elisabeth, was the daughter of a rich manufacturer who had brought money and land into the family. The Humboldt name was held in high regard in Berlin and the future king was even Alexander's godfather. But despite their privileged upbringing, Alexander and his older brother, Wilhelm, had an unhappy childhood. Their beloved father died suddenly when Alexander was nine and their mother never showed her sons much affection. Where their father had been charming and friendly, their mother was formal, cold and emotionally distant. Instead of maternal warmth, she provided the best education then available in Prussia, arranging for the two boys to be privately tutored by a string of Enlightenment thinkers who instilled in them a love of truth, liberty and knowledge.

These were strange relationships in which the boys sometimes searched for a father figure. One tutor in particular, Gottlob Johann Christian Kunth, who oversaw their education for many years, taught them with a peculiar combination of expressing displeasure and disappointment while at the same time encouraging a sense of dependency. Hovering behind them and watching over their shoulders as they calculated, translated Latin texts or learned French vocabulary, Kunth constantly corrected the brothers. He was never quite satisfied with their progress. Whenever they made a mistake, Kunth reacted as if they had done so to hurt or offend him. For the boys, this behaviour was more painful than if he had spanked them with a cane. Always desperate to please Kunth, as Wilhelm later recounted, they had felt a 'perpetual anxiety' to make him happy.

It was particularly difficult for Alexander who was taught the same

lessons as his precocious brother, despite being two years younger. The result was that he believed himself to be less talented. When Wilhelm excelled in Latin and Greek, Alexander felt incompetent and slow. He struggled so much, Alexander later told a friend, that his tutors 'were doubtful whether even ordinary powers of intelligence would ever be developed in him'.

Schloss Tegel and the surrounding estate

Wilhelm lost himself in Greek mythology and histories of ancient Rome, but Alexander felt restless with books. Instead he escaped the classroom whenever he could to ramble through the countryside, collecting and sketching plants, animals and rocks. When he returned with his pockets full of insects and plants his family nicknamed him 'the little apothecary', but they didn't take his interests seriously. According to family lore, one day the Prussian king, Frederick the Great, asked the boy if he planned to conquer the world like his namesake, Alexander the Great. Young Humboldt's answer was: 'Yes, Sir, but with my head.'

Much of his early life, Humboldt later told a close friend, was spent among people who loved him but who didn't understand him. His teachers were demanding and his mother lived withdrawn from society and her sons. Marie Elisabeth von Humboldt's greatest concern was,

by the idea that nature functioned like a complex apparatus – a 'great and complicated Machine of the Universe', as one scientist had said. After all, if man could make intricate clocks and automata, what great things could God create? According to the French philosopher René Descartes and his followers, God had given this mechanical world its initial push, while Isaac Newton regarded the universe more like a divine clockwork, with God as the maker continuing to intervene.

Inventions such as telescopes and microscopes revealed new worlds and with them a belief that the laws of nature could be discovered. In Germany the philosopher Gottfried Wilhelm von Leibniz had in the late seventeenth century propounded ideas of a universal science based on mathematics. Meanwhile in Cambridge, Newton had been uncovering the mechanics of the universe by applying mathematics to nature. As a result, the world began to be seen as reassuringly predictable, as long as humankind could comprehend those natural laws.

Maths, objective observation and controlled experiments paved this path of reason across the western world. Scientists became citizens of their self-proclaimed 'republic of letters', an intellectual community that transcended national boundaries, religion and language. As their letters zigzagged across Europe and the Atlantic, scientific discoveries and new ideas spread. This 'republic of letters' was a country without borders, ruled by reason and not by monarchs. It was in this new Age of Enlightenment that Alexander von Humboldt was raised, with western societies seemingly striding forward along a trajectory of confidence and improvement. With progress as the century's watchword, every generation envied the next. No one worried that nature itself might be destroyed.

As young men, Alexander and Wilhelm von Humboldt joined Berlin's intellectual circles, where they discussed the importance of education, of tolerance and of independent reasoning. As the brothers dashed from reading groups to philosophical salons in Berlin, learning, previously such a solitary occupation in Tegel, now became social. During the summers their mother often stayed behind in Tegel, leaving the two young brothers with their tutors at the family's house in Berlin. But this freedom was not to last: their mother made it clear that she expected them to become civil servants. Financially dependent on her, they had to accede to her wishes.

Marie Elisabeth von Humboldt sent eighteen-year-old Alexander to university in Frankfurt an der Oder. Some seventy miles west of Berlin, this provincial institution had only 200 students, and she had probably chosen it for its closeness to Tegel rather than its academic merit. After

Alexander had completed a semester of government administration studies and political economy there, it was decided that he was ready to join Wilhelm in Göttingen, one of the best universities in the German states. Wilhelm studied law and Alexander focused on science, mathematics and languages. Though the brothers were in the same town, they spent little time together. 'Our characters are too different,' Wilhelm said. While Wilhelm studied hard, Alexander dreamed of the tropics and adventures. He longed to leave Germany. As a boy Alexander had read the journals of Captain James Cook and Louis Antoine de Bougainville, both of whom had circumnavigated the globe, and imagined himself far away. When he saw the tropical palms at the botanical garden in Berlin, all he wanted to do was see them in their natural environments.

This youthful wanderlust became more serious when Humboldt joined an older friend, Georg Forster, on a four-month trip across Europe. Forster was a German naturalist who had accompanied Cook on his second voyage around the world. Humboldt and Forster had met in Göttingen. They often talked about the expedition, and Forster's lively descriptions of the South Pacific islands made Humboldt's longing to travel even stronger.

In the spring of 1790, Forster and Humboldt went to England, the Netherlands and France but the highlight of their journey was London, where everything made Humboldt think of distant countries. He saw the Thames choked with vessels bringing goods from all corners of the globe. Some 15,000 ships entered the port every year loaded with spices from the East Indies, sugar from the West Indies, tea from China, wine from France and timber from Russia. The whole river was a 'black forest' of masts. In between the large trading ships were hundreds of barges, wherries and smaller boats. Undoubtedly crowded and congested, it was also a magnificent portrait of Britain's imperial might.

A view of London and the Thames

In London, Humboldt was introduced to botanists, explorers, artists and thinkers. He met Captain William Bligh (of the infamous mutiny on the *Bounty*), and Joseph Banks, Cook's botanist on his first voyage around the world, and by now the president of the Royal Society, the most important scientific forum in Britain. Humboldt admired the beguiling paintings and sketches that William Hodges, the artist who had joined Cook's second voyage, had brought back. Wherever Humboldt turned, new worlds were conjured up. Even in the early mornings, the first things he saw when he opened his eyes were the framed engravings of the East India Company ships that decorated the bedroom walls in his lodgings. Humboldt often wept when he saw these painful reminders of his unfulfilled dreams. 'There is a drive in me,' he wrote, 'that often makes me feel as if I'm losing my mind.'

When the sadness became unbearable, he went on long solitary walks. On one such excursion through the countryside in Hampstead just north of London, he saw a recruiting notice nailed to a tree, calling for young sailors. For a brief moment he thought he had found an answer to his wishes but then he remembered his strict mother. Humboldt felt an inexplicable pull towards the unknown, what the Germans call *Fernweh* – a longing for distant places – but he was 'too good a son', he conceded, to turn against her.

He was slowly going crazy, he believed, and began to write 'mad letters' to his friends back home. 'My unhappy circumstances,' Humboldt wrote to one friend on the eve of his departure from England, 'force me to want what I can't have, and to do what I don't like.' But he still didn't dare to challenge his mother's expectations of what an upbringing in the Prussian elite entailed.

Back home Humboldt's misery became a frantic energy. He was impelled by a 'perpetual drive', he wrote, as if chased by '10,000 pigs'. He darted back and forth, jumping from one subject to another. No longer did he feel insecure about his intellectual abilities or think himself lagging behind his older brother. He was proving to himself, his friends and family just how clever he was. Forster was convinced that Humboldt's 'brain has been sadly overworked' – and he was not the only one. Even Wilhelm von Humboldt's fiancée, Caroline von Dachröden, who had only met Alexander recently, was concerned. She liked Alexander, but she feared that he was going to 'snap'. Many who knew him often remarked on this restless activity and how fast he spoke – at 'race-horse speed'.

Then, in the late summer of 1790, Humboldt began to study finance and economics at the academy of trade in Hamburg. He hated it for it

was all numbers and account books. In his spare time, Humboldt delved into scientific treatises and travel books, he learned Danish and Swedish – anything was better than his business studies. Whenever he could, he walked down to the River Elbe in Hamburg where he watched the large merchant vessels that brought tobacco, rice and indigo from the United States. The 'sight of the ships in the harbour', he told a friend, was what held him together – a symbol of his hopes and dreams. He couldn't wait to be finally the 'master of his own luck'.

By the time he finished his studies in Hamburg, Humboldt was twenty-one. Once again accommodating his mother's wishes, he enrolled in June 1791 at the prestigious mining academy in Freiberg, a small town near Dresden. It was a compromise that would prepare him for a career in the Prussian Ministry of Mines – to appease his mother – but at least allowed him to indulge his interest in science and geology. The academy was the first of its kind, teaching the latest geological theories in the context of their practical application for mining. It was also home to a thriving scientific community, having attracted some of the best students and professors from across Europe.

Within eight months Humboldt had completed a study programme that took others three years. Every morning he rose before sunrise and drove to one of the mines around Freiberg. He spent the next five hours deep in the shafts, investigating the construction of the mines, the working methods and the rocks. It helped that he was so lithe and wiry, moving easily through the narrow tunnels and low caves as he drilled and chiselled to take samples back home. He worked so ferociously that he often didn't notice the cold or damp. By noon he crawled out of the darkness, dusted himself clean and rushed back to the academy for seminars and lectures on minerals and geology. In the evenings, and often until deep into the night, Humboldt sat at his desk, hunched over his books by candlelight, reading and studying. During his free time, he investigated the influence of light (or its lack) on plants and collected thousands of botanical specimens. He measured, noted and classified. He was a child of the Enlightenment.

Only a few weeks after he had arrived in Freiberg, he had to ride to Erfurt, some 100 miles to the west, to attend his brother's wedding to Caroline. But as so often, Humboldt combined social events or family celebrations with work. Instead of simply joining the festivities in Erfurt, he turned it into a 600-mile geological expedition through the region of Thuringia. Caroline was half amused and half concerned about her frenzied new brother-in-law. She enjoyed his energy but also sometimes made fun of him – as a sister might tease a younger brother. Alexander

had his quirks and those should be respected, she told Wilhelm, but she was also worried about his state of mind and loneliness.

In Freiberg, Humboldt's only real friend was a fellow student, the son of the family from whom he had rented a room. The two young men spent day and night together, studying and talking. 'I have never loved someone so deeply,' Humboldt admitted, but also berated himself for forming such an intense bond because he knew that he would have to leave Freiberg after his studies and then feel even more lonely.

The hard work at the academy, though, paid off when Humboldt finished his studies and was made a mining inspector at the astonishingly young age of twenty-two, overtaking many more senior men. Half embarrassed by his stratospheric ascent, he was also vain enough to show off to friends and family in long letters. Most importantly, the position allowed him to travel thousands of miles in order to evaluate soils, shafts and ore – from coal in Brandenburg and iron in Silesia to gold in the Fichtel Mountains and salt mines in Poland.

During these travels, Humboldt met many people but rarely opened his heart. He was content enough, he wrote to friends, but certainly not happy. Late at night, after a full day in the mines or rattling along bad roads in his carriage, he thought of the few friends he had made over the past years. He felt 'damned, always lonely'. As he ate another meal on his own in a squalid tavern or inn somewhere along his route, he was often too tired to write or talk. Some nights, though, he was so lonely that the need to communicate conquered his fatigue. Then he picked up his pen and composed long letters that looped and jumped, from detailed treatises about his work and scientific observations to emotional outbursts and declarations of love and friendship.

He would give two years of his life for the memories of the time they had been together, he wrote to his friend in Freiberg, and confessed to have spent the 'sweetest hours of his life' with him. Written late at night, some of these letters were raw with emotion and shaped by a desperate loneliness. In page after page, Humboldt poured out his heart, and then excused his 'foolish letters'. The next day, when work demanded his attention, all was forgotten and it would often be weeks or even months until he wrote again. Even to the few who knew him best, Humboldt often remained elusive.

Meanwhile his career soared and his interests widened. Humboldt now also became interested in the working conditions of the miners whom he saw crawling into the bowels of the earth every morning. To improve their safety, he invented a breathing mask, as well as a lamp that would work even in the deepest oxygen-poor shafts. Shocked by

formulate new theories of life. When Humboldt was studying in Göttingen, Blumenbach had published a revised edition of his book *Über den Bildungstrieb*. In it Blumenbach presented a concept that explained that several forces existed within living organisms such as plants and animals. The most important was what he called the *Bildungstrieb* – the 'formative drive' – a force that shaped the formation of bodies. Every living organism, from humans to mould, had this formative drive, Blumenbach wrote, and it was essential for the creation of life.

For Humboldt nothing less was at stake in his experiments than the undoing of what he called the 'Gordian knot of the processes of life'.

2

Imagination and Nature

Johann Wolfgang von Goethe and Humboldt

In 1794 ALEXANDER von Humboldt briefly interrupted his experiments and his mining inspection tours to visit his brother, Wilhelm, who now lived with his wife Caroline and their two young children in Jena, some 150 miles south-west of Berlin. Jena was a town of only 4,000 people that lay within the Duchy of Saxe-Weimar, a small state that was headed by an enlightened ruler, Karl August. It was a centre of learning and literature that within a few years was to become the birthplace of German Idealism and Romanticism. The University of Jena had become one of the largest and most famous in the German-speaking regions, attracting progressive thinkers from across the other more repressive German states because of its liberal attitude. There was no other place, said the resident poet and playwright Friedrich Schiller, where liberty and truth ruled so much.

Fifteen miles from Jena was Weimar, the state's capital, and the home of Johann Wolfgang von Goethe, Germany's greatest poet. Weimar had fewer than 1,000 houses and was said to be so small that everybody knew everybody. Cattle were driven through the cobbled streets and the post was delivered so irregularly that it was easier for Goethe to send a letter to his friend Schiller, who worked at the university in Jena, with his greengrocer on her delivery rounds rather than wait for the mail coach.

In Jena and Weimar, one visitor said, the brightest minds came together like the sunrays in a magnifying glass. Wilhelm and Caroline had moved to Jena in spring 1794 and were part of the circle of friends around Goethe and Schiller. They lived on the market square opposite Schiller – so close that they could wave out of the window to arrange their daily meetings. When Alexander arrived, Wilhelm dispatched a quick note to Weimar, inviting Goethe to Jena. Goethe was happy to come and stayed, as always, in his guest rooms at the duke's castle, not far away from the market square, just a couple of blocks north.

During Humboldt's visit, the men met every day. They made a lively group. There were noisy discussions and roaring laughter – frequently until late at night. Despite his youth, Humboldt often took the lead. He 'forced us' into the natural sciences, Goethe enthused, as they talked about zoology and volcanoes, as well as about botany, chemistry and Galvanism. 'In eight days of reading books, one couldn't learn as much as what he gives you in an hour,' Goethe said.

December 1794 was bitterly cold. The frozen Rhine became a thoroughfare for Napoleon's troops on their warpath through Europe. Deep snow blanketed the Duchy of Saxe-Weimar. But every morning just before sunrise, Humboldt, Goethe and a few other scientific friends trudged through the darkness and snow across Jena's market square. Wrapped up in thick woollen coats, they passed the sturdy fourteenth-century town hall on their walk to the university where they attended lectures on anatomy. It was freezing in the almost empty auditorium in the medieval round stone tower that was part of the ancient city wall – but the advantage of the unusually low temperatures was that the cadavers they dissected there remained fresh for much longer. Goethe, who hated the cold and normally would have preferred the crackling heat of his stove, could not have been happier. He couldn't stop talking. Humboldt's presence stimulated him.

Then in his mid-forties, Goethe was Germany's most celebrated literary figure. Exactly two decades previously, he had been catapulted to international fame with *The Sorrows of Young Werther*, a novel about a forlorn lover who commits suicide, which had encapsulated the sentimentality of that time. It became *the* book of a whole generation and many identified with the eponymous protagonist. The novel was published in most European languages and became so popular that countless men, including young Karl August, the Duke of Saxe-Weimar, had dressed in a *Werther* uniform consisting of a yellow waistcoat and breeches, blue tailcoat, brown boots and round felt hat. People talked of *Werther* fever and the Chinese even produced *Werther* porcelain aimed at the European market.

When Goethe first met Humboldt, he was no longer the dazzling young poet of the *Sturm und Drang*, the era of 'Storm and Stress'. This German pre-Romantic period had celebrated individuality and a full spectrum of extreme feelings – from dramatic love to deep melancholy – all filled with passion, emotions, romantic poems and novels. In 1775, when Goethe had first been invited to Weimar by the then eighteen-year-old Karl August, he had embarked on a long round of love affairs, drunkenness and pranks. Goethe and Karl August had roistered through the streets of Weimar, sometimes wrapped in white sheets to scare those

Johann Wolfgang von Goethe in 1787

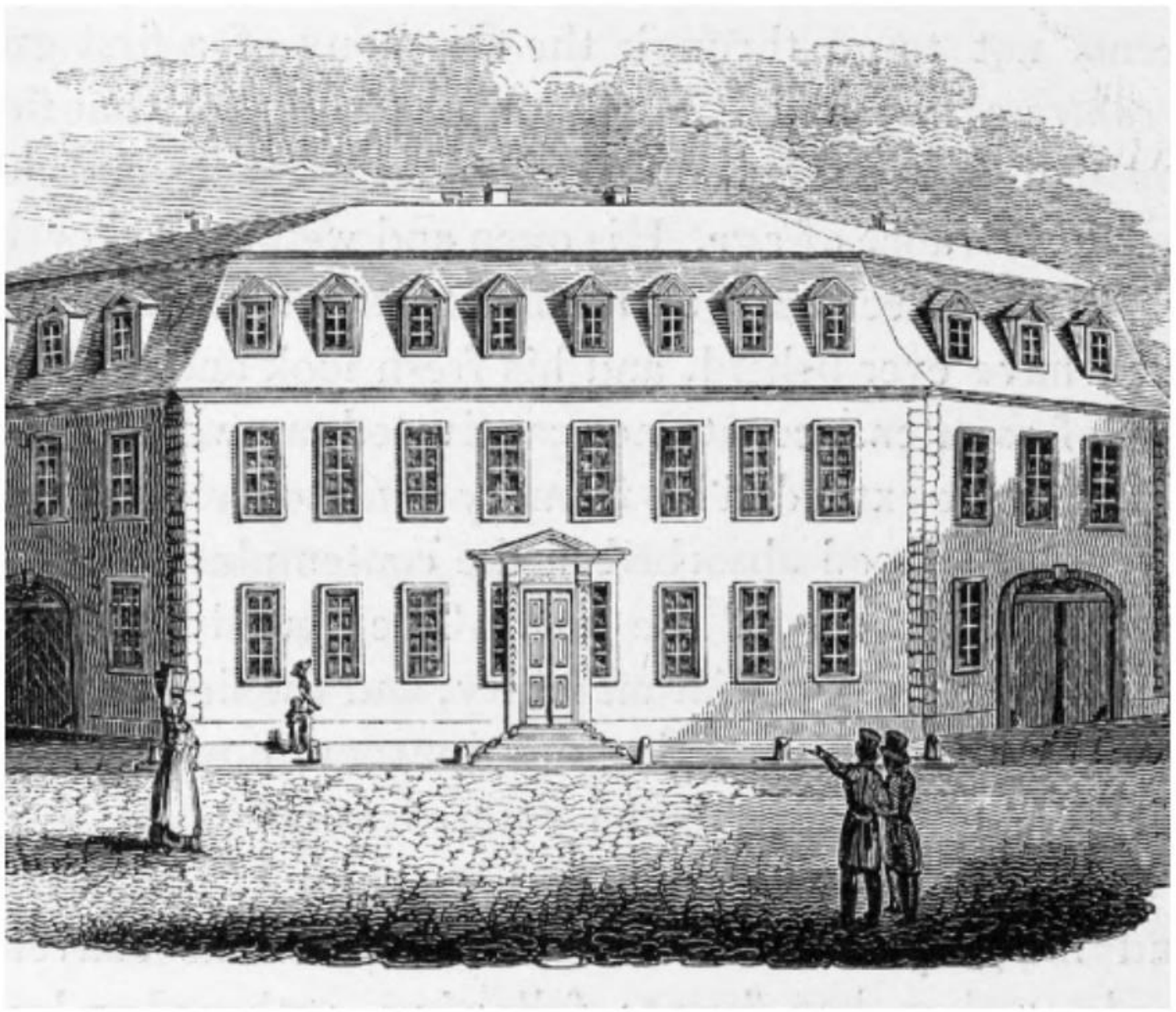
who believed in ghosts. They had stolen barrels from a local merchant to roll down hills, and flirted with peasant girls – all in the name of genius and freedom. And, of course, no one could complain since Karl August, the young ruler, was involved. But those wild years were long gone, and with them the theatrical declamations of love, the tears, the smashing of glasses and naked swimming that had scandalized the locals. In 1788, six years before Humboldt's first visit, Goethe had shocked Weimar society one more time when he had taken the uneducated Christiane Vulpius as his lover. Christiane, who worked as a seamstress in Weimar, gave birth to their son August less than two years later. Ignoring convention and malicious gossip, Christiane and August lived with Goethe.

By the time Goethe met Humboldt, he had calmed down and grown corpulent, with a double chin and a stomach cruelly described by one acquaintance as 'that of a woman in the last stages of pregnancy'. His looks had gone – his beautiful eyes had disappeared into the 'fat of his cheeks' and many remarked that he was no longer a dashing 'Apollo'. Goethe was still the confidant of and adviser to the Duke of Saxe-Weimar who had ennobled him (thus the 'von' in Johann Wolfgang von Goethe's name). He was the director of the court theatre and held

several well-paid administrative positions which included the control of the duchy's mines and manufacturing. Like Humboldt, Goethe adored geology (and mining) – so much so that on special occasions he dressed his young son in a miner's uniform.

Goethe had become the Zeus of Germany's intellectual circles, towering above all other poets and writers, but he could also be a 'cold, monosyllabled God'. Some described him as melancholic, others as arrogant, proud and bitter. Goethe had never been a great listener if the topic was not to his liking and could end a discussion with a blatant display of his lack of interest or by abruptly changing the subject. He was sometimes so rude particularly to young poets and thinkers that they regularly ran out of the room. None of this mattered to his admirers. The 'sacred poetic fire', as one British visitor to Weimar said, had only burned to perfection in Homer, Cervantes, Shakespeare and now it did so in Goethe.

But Goethe wasn't happy. 'No one was more isolated than I was then.' He was more fascinated by nature – 'the great Mother' – than by people. His large house in Weimar's town centre reflected his tastes and



Goethe's house in Weimar

'whipped the scientific things' with such speed that it was sometimes hard to follow.

Three years after his first visit, Humboldt arrived in Jena for a three-month break. Once again Goethe joined him there. Instead of going back and forth to Weimar, Goethe moved to his rooms at the Old Castle in Jena for a few weeks. Humboldt wanted to conduct a long series of experiments on 'animal electricity' because he was trying to finish his book on the subject. Almost every day – often with Goethe – Humboldt walked the short distance from his brother's house to the university. He spent six or seven hours in the anatomy theatre as well as lecturing on the subject.

When a violent thunderstorm hit the area one warm spring day, Humboldt dashed outside to set up his instruments in order to measure the electricity in the atmosphere. As the rain lashed down and thunder reverberated across the fields, the small town was illuminated by a wild dance of lightning. Humboldt was in his element. The next day, when he heard that a farmer and his wife had been killed by the lightning, he rushed over to obtain their corpses. Laying out their bodies on the table in the round anatomy tower, he analysed everything: the man's leg bones looked as if they had been 'pierced by shotgun pellets!', Humboldt noted excitedly, but the worst damage was to the genitals. At first he thought that the pubic hair might have ignited and caused the burns, but dismissed the idea when he saw the couple's unharmed armpits. Despite the increasingly putrid smell of death and burned flesh, Humboldt enjoyed every minute of this gruesome investigation. 'I cannot exist without experiments,' he said.

Humboldt's favourite experiment was one that he and Goethe discovered together by chance. One morning Humboldt placed a frog's leg on a glass plate and connected its nerves and muscles to different metals in sequence – to silver, gold, iron, zinc and so on – but generated only a discouraging gentle twitch in the leg. When he then leaned over the leg in order to check the connecting metals, it convulsed so violently that it leapt off the table. Both men were stunned, until Humboldt realized that it had been the moisture of his breath that had triggered the reaction. As the tiny droplets in his breath had touched the metals they had created an electric current that had moved the frog's leg. It was the most magical experiment he had ever carried out, Humboldt decided, because by exhaling on to the frog's leg it was as if he were 'breathing life into it'. It was the perfect metaphor for the emergence of the new life sciences.

In this context they also discussed the theories of Humboldt's former professor, Johann Friedrich Blumenbach, about the forces that shaped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light and investigated the luminescence of phosphor. In the afternoons or evenings they sometimes met at Wilhelm's and Caroline's house but more often assembled at Friedrich Schiller's house on the market square, where Goethe recited his poems and others presented their own work until late at night. Goethe was so exhausted that he admitted to almost looking forward to a few peaceful days in Weimar 'to recover'.

Alexander von Humboldt's pursuit of knowledge was so infectious, Goethe told Schiller, that his own scientific interests had been woken from hibernation. Schiller, though, worried that Goethe was being pulled too far away from poetry and aesthetics. All this was Humboldt's fault, Schiller believed. Schiller also thought that Humboldt would never accomplish anything great because he dabbled in too many subjects. Humboldt was only interested in measurements and, despite the richness of his knowledge, his work displayed a 'poverty of meaning'. Schiller remained a lone, negative voice. Even the friend he confided in disagreed: yes, Humboldt was enthusiastic about measurements but these were the building blocks for his wider understanding of nature.

After a month in Jena, Goethe returned to Weimar but quickly missed his new-found stimulation and immediately invited Humboldt to visit. Five days later Humboldt arrived in Weimar and stayed for a week. The first evening Goethe kept his guest to himself but on the next day they had lunch at the castle with Karl August followed by a big dinner party at Goethe's house. Goethe showed off what Weimar had to offer: he took Humboldt to see the landscape paintings in the duke's collections, as well as some geological specimens that had just arrived from Russia. Almost every day they went for meals at the castle, where Karl August invited Humboldt to conduct some experiments to entertain his guests. Humboldt had to oblige but he thought the time spent at court was utterly wasted.

For the next month, until Humboldt's final departure from Jena, Goethe commuted between his house in Weimar and his rooms in the castle in Jena. They read natural history books together, and went out for long walks. In the evening they shared meals and reviewed the latest philosophical texts. They now often met at Schiller's newly bought Garden House, just outside the city walls. Schiller's garden was bordered by a little river at the back where the men sat in a small arbour. A round stone table in the middle was laden with glasses and plates of food but also with books and papers. The weather was glorious and they enjoyed the mild early summer evenings. At night, they could only hear the gurgling of the stream and the song of the nightingale. They talked about 'art, nature and the mind', as Goethe wrote in his diary.


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It was also around this time that both read Erasmus Darwin's popular poem *Loves of the Plants*. The grandfather of Charles Darwin, Erasmus was a physician, inventor and scientist who in his poem had turned the Linnaean sexual classification system of plants into verses crowded with lovesick violets, jealous cowslips and blushing roses. Populated by horned snails, fluttering leaves, silver moonlight and lovemaking on 'moss-embroider'd beds', *Loves of the Plants* had become the most talked-about poem in England.

Four decades later, Humboldt would write to Charles Darwin how much he had admired his grandfather for proving that a mutual admiration for nature *and* imagination was 'powerful and productive'. Goethe was not quite as impressed. He liked the idea of the poem but found its execution too pedantic and rambling, commenting to Schiller that the verses lacked any trace of 'poetic feeling'.

Goethe believed in the marriage of art and science, and his reawakened fascination with science did not – as Schiller had feared – remove him from his art. For too long poetry and science had been regarded as the 'greatest antagonists', Goethe said, but now he began to infuse his literary work with science. In *Faust*, Goethe's most famous play, the drama's main protagonist, the restless scholar Heinrich Faust, makes a pact with the devil, Mephistopheles, in exchange for infinite knowledge. Published in two separate parts as *Faust I* and *Faust II* in 1808 and 1832, Goethe wrote *Faust* in bursts of activity that often coincided with Humboldt's visits. Faust, like Humboldt, was driven by a relentless striving for knowledge, by a 'feverish unrest', as he declares in the play's first scene. At the time when he was working on *Faust*, Goethe said about Humboldt: 'I've never known anyone who combined such a deliberately channelled activity with such plurality of the mind' – words that might have described Faust. Both Faust and Humboldt believed that ferocious activity and enquiry brought understanding – and both found strength in the natural world and believed in the unity of nature. Like Humboldt, Faust was trying to discover 'all Nature's hidden powers'. When Faust declares his ambition in the first scene, 'That I may detect the inmost force / Which binds the world, and guides its course', it could have been Humboldt speaking. That something of Humboldt was in Goethe's *Faust* – or something of *Faust* in Humboldt – was obvious to many; so much so that people commented on the resemblance when the play was finally published in 1808.*

* Others also made connections between Humboldt and Mephistopheles. Goethe's niece said that 'Humboldt seemed to her as Mephistopheles did to Gretchen' –

3
In Search of a Destination

As HUMBOLDT TRAVELLED across the vast Prussian territory, inspecting mines and meeting scientific friends, he continued to dream of faraway countries. That longing never disappeared but he also knew that his mother, Marie Elisabeth von Humboldt, had never shown any patience with his adventurous dreams. She expected him to climb the ranks of the Prussian administration and he felt 'chained' to her wishes. All that changed when she died of cancer in November 1796 after battling the disease for more than a year.

Perhaps unsurprisingly, neither Wilhelm nor Alexander grieved much for their mother. She had always found fault in whatever her sons did, Wilhelm confided to his wife, Caroline. No matter how successfully they had completed their studies or excelled in their careers, she had never been satisfied. During her illness, Wilhelm had dutifully moved from Jena to Tegel and Berlin to look after her, but he had missed the intellectual stimulation in Jena. Oppressed by his mother's dark presence, he couldn't read, work or think. He felt paralysed, Wilhelm had written to Schiller. When Alexander briefly visited, he had left as soon as possible, leaving his brother in charge. After fifteen months Wilhelm had not been able to bear the vigil any longer and returned to Jena. Two weeks later their mother died, with neither son at her bedside.

The brothers did not attend her funeral. Other events seemed of greater importance; Alexander was more excited about the attention that his new miner's lamps were receiving, along with his experiments in Galvanism. Four weeks after his mother's death, Alexander was announcing his preparations for his 'great voyage'. Having waited for years for the opportunity to control his own destiny, he finally felt unshackled at the age of twenty-seven. Her death didn't affect him much, he confessed to his old friend from Freiberg, because they had been 'strangers to each other'. Over the previous few years Humboldt had spent as little time as possible at the family home and whenever he left Tegel, he had been relieved. As one close friend wrote to Humboldt: 'her death . . . must be particularly welcomed by you.'

It was also in Paris that Humboldt first ran into a young French scientist, Aimé Bonpland, in the hallway of the house where both were renting a room. With a battered botany box – a vasculum – slung across his shoulder, Bonpland was obviously also interested in plants. He had been taught by the best French naturalists in Paris, and, as Humboldt learned, was a talented botanist, skilled in comparative anatomy, and had also served as a surgeon in the French navy. Born in La Rochelle, a port town on the Atlantic coast, the twenty-five-year-old Bonpland was from a naval family with a love for adventures and voyages in his blood. Bumping into each other regularly in the corridors of their accommodation, Bonpland and Humboldt began to talk and quickly discovered a mutual adoration for plants and foreign travels.

Like Humboldt, Bonpland was keen to see the world. Humboldt decided that Bonpland would be the perfect companion. Not only was he passionate about botany and the tropics, but he was also good-natured and charming. Stoutly built, Bonpland exuded a solid strength that promised resilience, good health and reliability. In many ways, he was Humboldt's exact opposite. Where Humboldt spread frantic activity, Bonpland carried an air of calmness and docility. They were to make a great team.

In the midst of all the preparations, Humboldt now seemed to experience flashes of guilt about his late mother. There were rumours, Friedrich Schiller told Goethe, that 'Alexander couldn't get rid of the spirit of his mother'. Apparently she appeared to him all the time. A mutual acquaintance had told Schiller that Humboldt was participating in some dubious séances in Paris involving her. Humboldt had always been afflicted by a 'great fear of ghosts', as he had admitted to a friend a few years previously, but now it had got much worse. No matter how much he cast himself as a rational scientist, he felt his mother's spirit watching his every move. It was time to escape.

The immediate problem, though, was that the command of Bougainville's expedition was given to a younger man, Captain Nicolas Baudin. Though Humboldt received reassurances that he could join Baudin on his voyage, the whole expedition foundered due to a lack of government funds. Humboldt refused to give up. He now wondered if he could join the 200 scholars who accompanied Napoleon's army which had left Toulon in May 1798 to invade Egypt. But how to get there? Few, Humboldt admitted, 'have had greater difficulties'.

As the quest for a ship continued, Humboldt contacted the Swedish consul in Paris who promised to procure him a passage from Marseille to Algiers, on the North African coast, from where he could travel

overland to Egypt. Humboldt also asked his London acquaintance, Joseph Banks, to obtain a passport for Bonpland in case they encountered an English warship. He was prepared for all eventualities. Humboldt himself travelled with a passport issued by the Prussian ambassador in Paris. Along with his name and age, the document gave a rather detailed, though not exactly objective, description stating that he had grey eyes, a large mouth, a big nose and a 'well-formed chin'. Humboldt scribbled in the margins in jest: 'large mouth, fat nose, but chin *bien fait*'.

At the end of October Humboldt and Bonpland rushed to Marseille ready to leave immediately. But nothing happened. For two months, day after day, they climbed the hill to the old church of Notre-Dame de la Garde to scan the harbour. Every time they saw the white glimmer of a sail on the horizon, their hopes rose. When news reached them that their promised frigate had been badly damaged in a storm, Humboldt decided to charter his own vessel but quickly discovered that regardless of all the money he had, the recent naval battles made it impossible to find a ship. Wherever he turned, 'all hopes were shattered', he wrote to an old friend in Berlin. He was exasperated – his pockets full of money and his mind brimming with the latest scientific knowledge, yet still not able to travel. War and politics, Humboldt said, stopped everything and 'the world is closed'.

Finally, at the end of 1798, almost exactly two years after his mother's death, Humboldt gave up on the French and travelled to Madrid to try his luck there. The Spanish were famous for their reluctance to let foreigners enter their territories, but with charm and a string of useful connections at the Spanish court, Humboldt managed to obtain the unlikely permission. In early May 1799 King Carlos IV of Spain provided a passport to the colonies in South America and the Philippines on the express condition that Humboldt financed the voyage himself. In return Humboldt promised to dispatch flora and fauna for the royal cabinet and garden. Never before had a foreigner been allowed such great freedom to explore their territories. Even the Spanish themselves were surprised by their king's decision.

Humboldt had no intention of wasting any more time. Five days after they received their passports, Humboldt and Bonpland left Madrid for La Coruña, a port at the north-western tip of Spain, where the frigate *Pizarro* was waiting for them. In early June 1799 they were ready to sail despite warnings that British warships had been sighted nearby. Nothing – neither cannons, nor a fear of the enemy – could spoil the moment. 'My head is dizzy with joy,' Humboldt wrote.

He had bought a great collection of the latest instruments, ranging

arrival at first as the whole island was shrouded in fog but when the thick mist lifted, Humboldt saw the sun illuminating the glistening white summit of the volcano Pico del Teide. He rushed to the bow of their ship, breathlessly catching a glimpse of the first mountain that he was going to climb outside Europe. With their ship scheduled to spend only a couple of days in Tenerife, there was not much time.

The next morning Humboldt, Bonpland and some local guides set off towards the volcano, without tents or coats, and armed only with some weak 'fir torches'. It was hot in the valleys but the temperature dropped rapidly as they ascended the volcano. When they reached the peak at more than 12,000 feet, the wind was so strong they could hardly stand. Their faces were frozen but their feet were burning from the heat emanating from the hot ground. It was painful but Humboldt couldn't care less. There was something in the air that created a 'magical' transparency, he said, an enticing promise of what was to come. He could hardly tear himself away but they had to get back to the ship.

Back on the *Pizarro*, the anchors were lifted and their journey continued. Humboldt was happy. His only complaint was that they were not allowed to light their lamps or candles at night for fear of attracting the enemy. For a man like Humboldt, who only needed a few hours' sleep, it was torture having to lie in the dark without anything to read, dissect or investigate. The further south they sailed, the shorter the days became and soon he was out of work by six o'clock in the evening. So he observed the night sky and, as many other explorers and sailors who had crossed the Equator, Humboldt marvelled at the new stars that appeared – constellations that only graced the southern sky and that were a nightly reminder of how far he had travelled. When he first saw the Southern Cross, Humboldt realized that he had achieved the dreams of his 'earliest youth'.

On 16 July 1799, forty-one days after they had left La Coruña in Spain, the coast of New Andalusia, today part of Venezuela, appeared on the horizon. Their first view of the New World was a voluptuous green belt of palms and banana groves that ran along the shore, beyond which Humboldt could make out tall mountains, their distant peaks peeping through layers of clouds. A mile inland and hugged by cacao trees lay Cumaná, a city founded by the Spanish in 1523, and almost destroyed by an earthquake in 1797, two years before Humboldt's arrival. This was to be their home for the next few months. The sky was of the clearest blue and there was not a trace of mist in the air. The heat was intense and the light dazzling. The moment that Humboldt stepped off the boat, he plunged his thermometer into the white sand: 37.7°C, he scribbled in his notebook.

interest in those who govern' the colonies, Humboldt was certain, he would face 'numberless inconveniences' during his time in the New World.

Yet, before presenting his paperwork to the governor of Cumaná, Humboldt soaked up the tropical scenery. Everything was so new and spectacular. Each bird, palm or wave 'announced the grand aspect of nature'. It was the beginning of a new life, a period of five years in which Humboldt would change from a curious and talented young man into the most extraordinary scientist of his age. It was here that Humboldt would see nature with both head and heart.