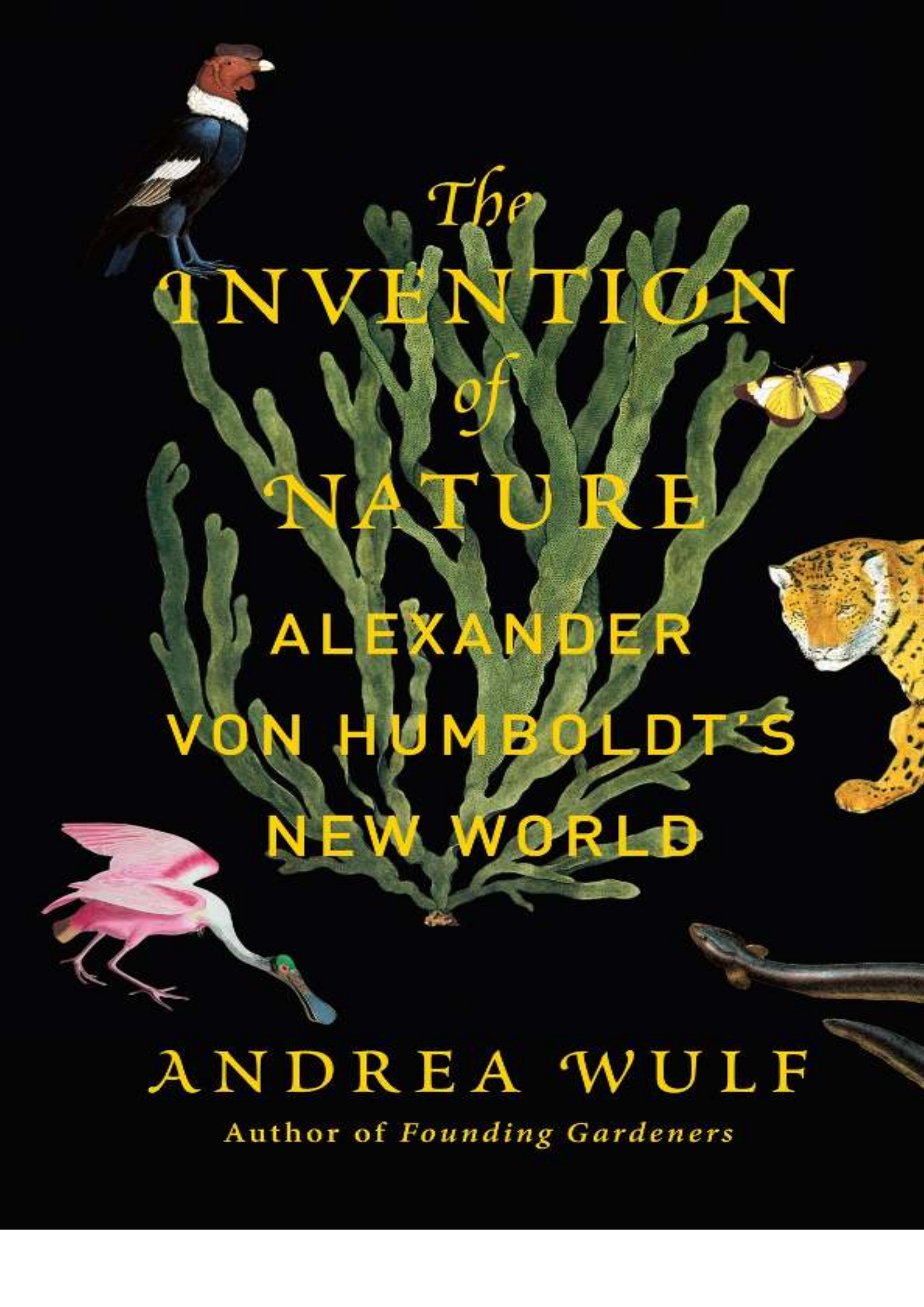
The
INVENTION
of
NATURE
ALEXANDER
VON HUMBOLDT'S
NEW WORLD
ANDREA WULF
Author of Founding Gardeners


ALFRED A. KNOPF
1915 · 100 YEARS · 2015

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The Invention of Nature

ALEXANDER VON HUMBOLDT'S NEW WORLD

Andrea Wulf

Alfred A. Knopf · New York

2015

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Close your eyes, prick your ears, and from the softest sound to the wildest noise, from the simplest tone to the highest harmony, from the most violent, passionate scream to the gentlest words of sweet reason, it is by Nature who speaks, revealing her being, her power, her life, and her relatedness so that a blind person, to whom the infinitely visible world is denied, can grasp an infinite vitality in what can be heard.

—Johann Wolfgang von Goethe

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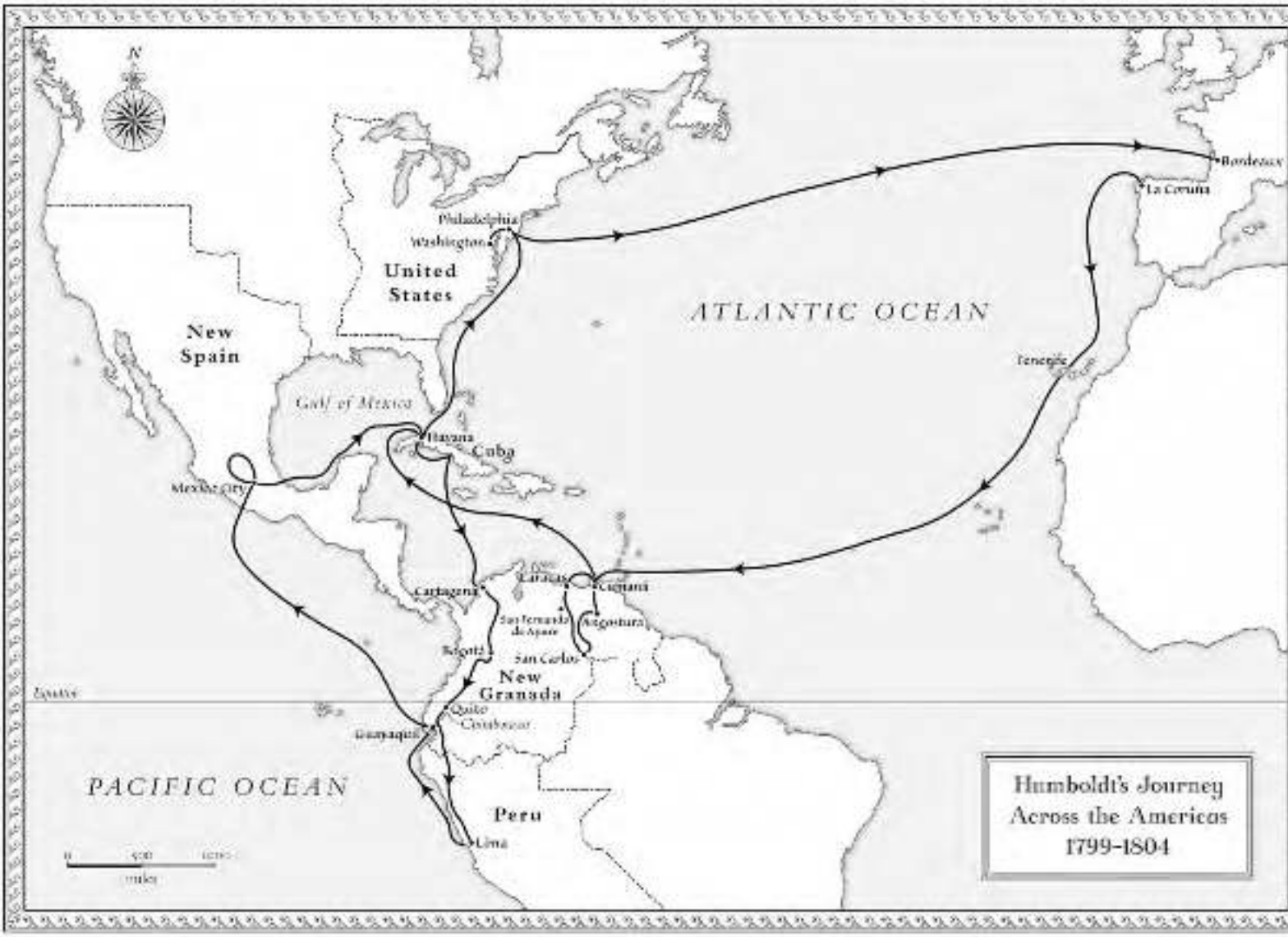
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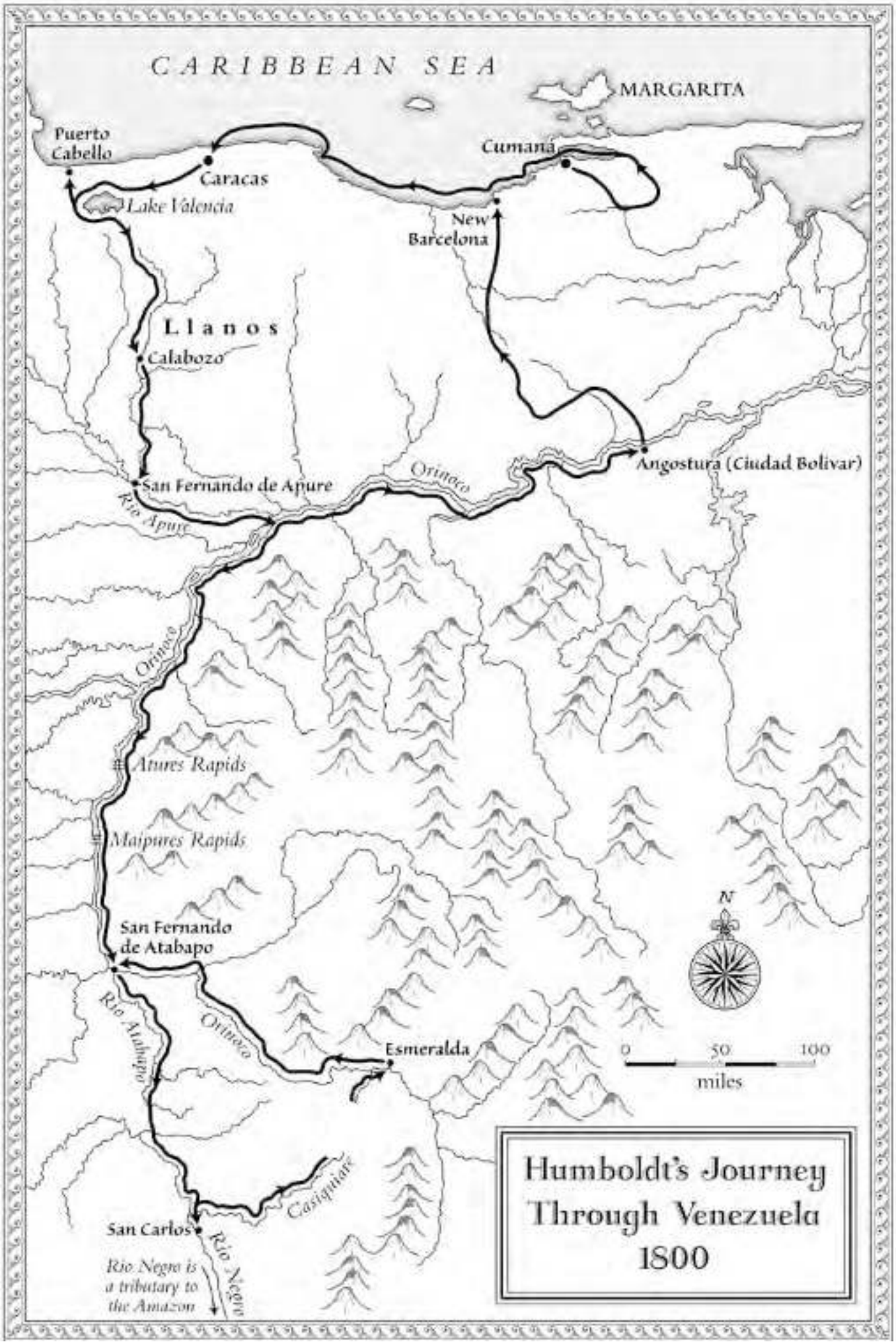
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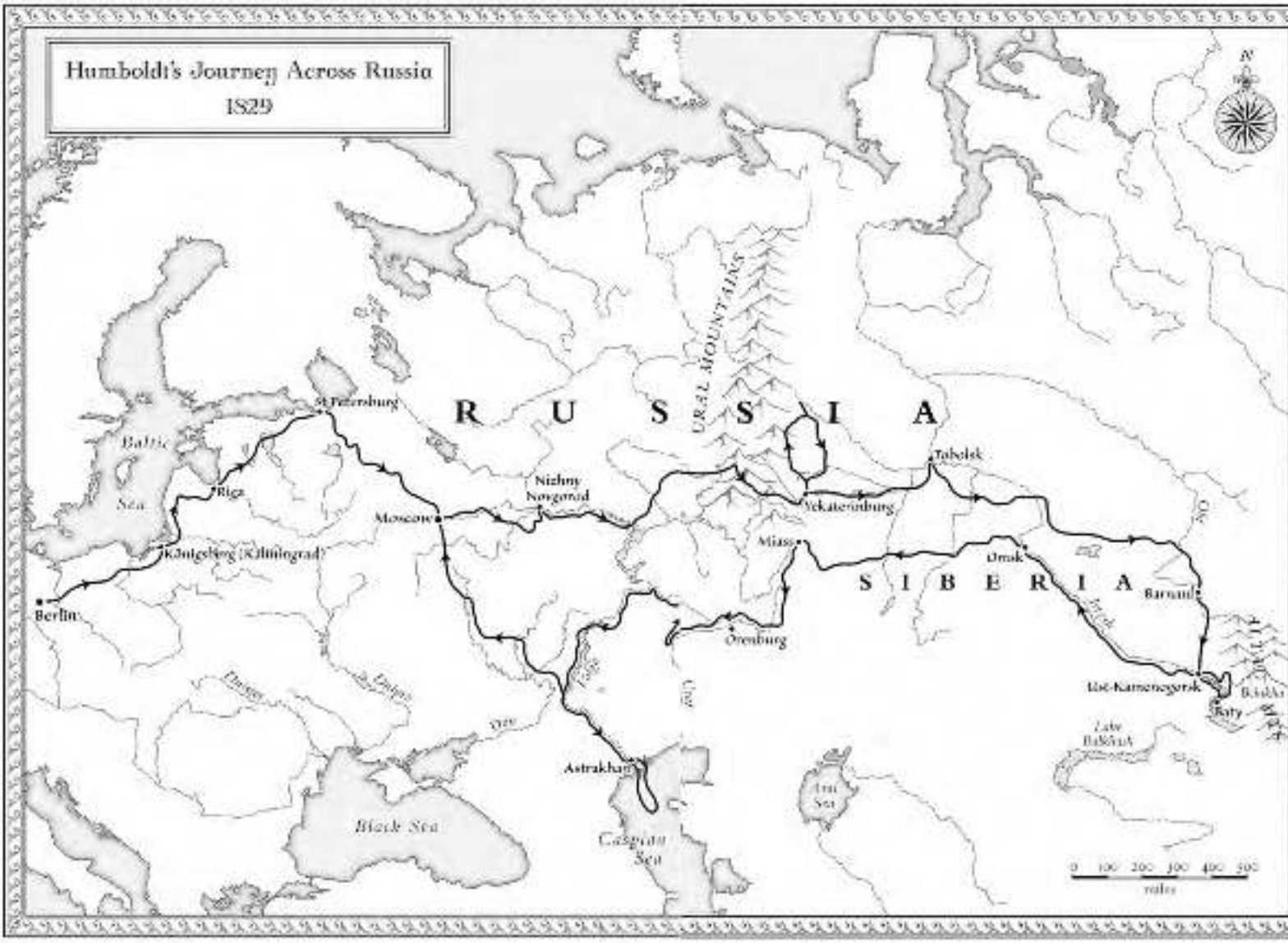
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Author's Note

Alexander von Humboldt's books have been published in many languages. When quoting from his book directly, I have compared the original German (where applicable) and contemporary English editions. Wher newer English editions have been available, I have checked those against the older translations and where I fe 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 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 *Person Narrative* that was published in Britain between 1814 and 1829 (translated by Helen Maria Williams), whi 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 wid The path, if you could call it that, was layered with sand and loose stones that shifted whenever touche Down to the left was a steep cliff encrusted with ice that glinted when the sun broke through the thick cloud The view to the right, with a 1,000-foot drop, wasn't much better. Here the dark, almost perpendicular wal were covered with rocks that protruded like knife blades.

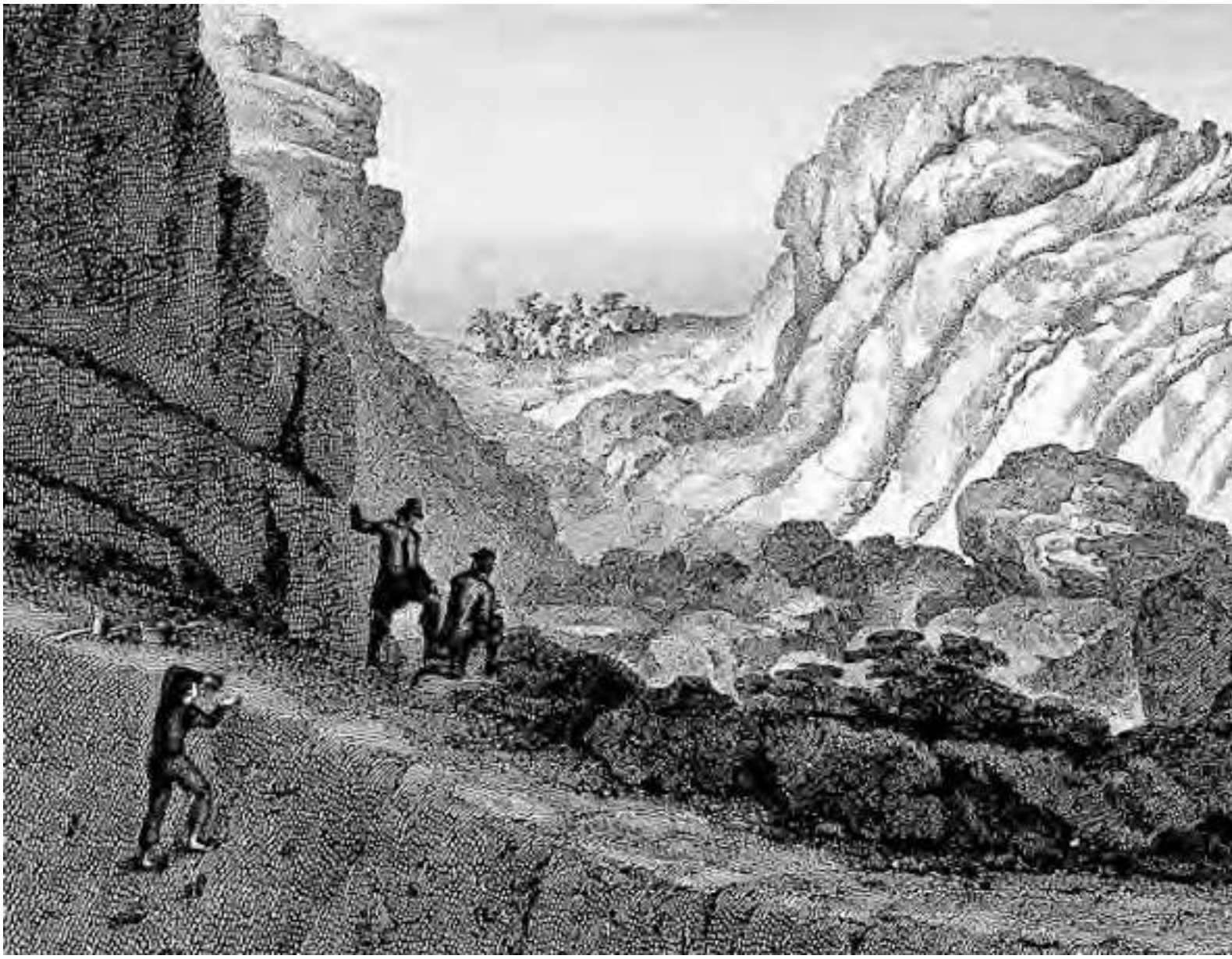
Alexander von Humboldt and his three companions moved in single file, slowly inching forward. Withou proper equipment or appropriate clothes, this was a dangerous climb. The icy wind had numbed their han and feet, melted snow had soaked their thin shoes and ice crystals clung to their hair and beards. At 17,000 fe above sea level, they struggled to breathe in the thin air. As they proceeded, the jagged rocks shredded th 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 th Andes that rose to almost 21,000 feet, some 100 miles to the south of Quito in today's Ecuador. Chimboraz was then believed to be the highest mountain in the world. No wonder that their terrified porters ha abandoned them at the snow line. The volcano's peak was shrouded in thick fog but Humboldt ha nonetheless pressed on.

For the previous three years, Alexander von Humboldt had been travelling through Latin Americ penetrating deep into lands where few Europeans had ever gone before. Obsessed with scientific observatio the thirty-two-year-old had brought a vast array of the best instruments from Europe. For the ascent Chimborazo, he had left most of the baggage behind, but had packed a barometer, a thermometer, a sextan an artificial horizon and a so-called 'cyanometer' with which he could measure the 'blueness' of the sky. A they climbed, Humboldt fumbled out his instruments with numb fingers, setting them upon precarious 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 li disappeared, because at that height there were no plants or insects. Even the condors that had accompanie their previous climbs were absent. As the fog whitewashed the air into an eerie empty space, Humboldt fe 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. 'magnificent sight', was Humboldt's first thought, but then he saw the huge crevasse in front of them – 65 fe wide and about 600 feet deep. But there was no other way to the top. When Humboldt measured the 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 the world, looking down upon the mountain ranges folded beneath him, Humboldt began to see the wor differently. He saw the earth as one great living organism where everything was connected, conceiving a bol new vision of nature that still influences the way that we understand the natural world.



Humboldt and his team climbing a volcano (Illustration Credit prl.1)

Described by his contemporaries as the most famous man in the world after Napoleon, Humboldt was one the most captivating and inspiring men of his time. Born in 1769 into a wealthy Prussian aristocratic famil he discarded a life of privilege to discover for himself how the world worked. As a young man he set out on five-year exploration to Latin America, risking his life many times and returning with a new sense of th world. It was a journey that shaped his life and thinking, and that made him legendary across the globe. H lived in cities such as Paris and Berlin, but was equally at home on the most remote branches of the Orinoc River or in the Kazakh Steppe at Russia's Mongolian border. During much of his long life, he was the nexu of the scientific world, writing some 50,000 letters and receiving at least double that number. Knowledg 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 Latin America, yet was chamberlain to two Prussian kings. He admired the United States for their concepts liberty and equality but never stopped criticizing their failure to abolish slavery. He called himself 'half American', but at the same time compared America to 'a Cartesian vortex, carrying away and levellin everything to dull monotony'. He was confident, yet constantly yearned for approval. He was admired for hi breadth of knowledge but also feared for his sharp tongue. Humboldt's books were published in a doze languages and were so popular that people bribed booksellers to be the first to receive copies, yet he died

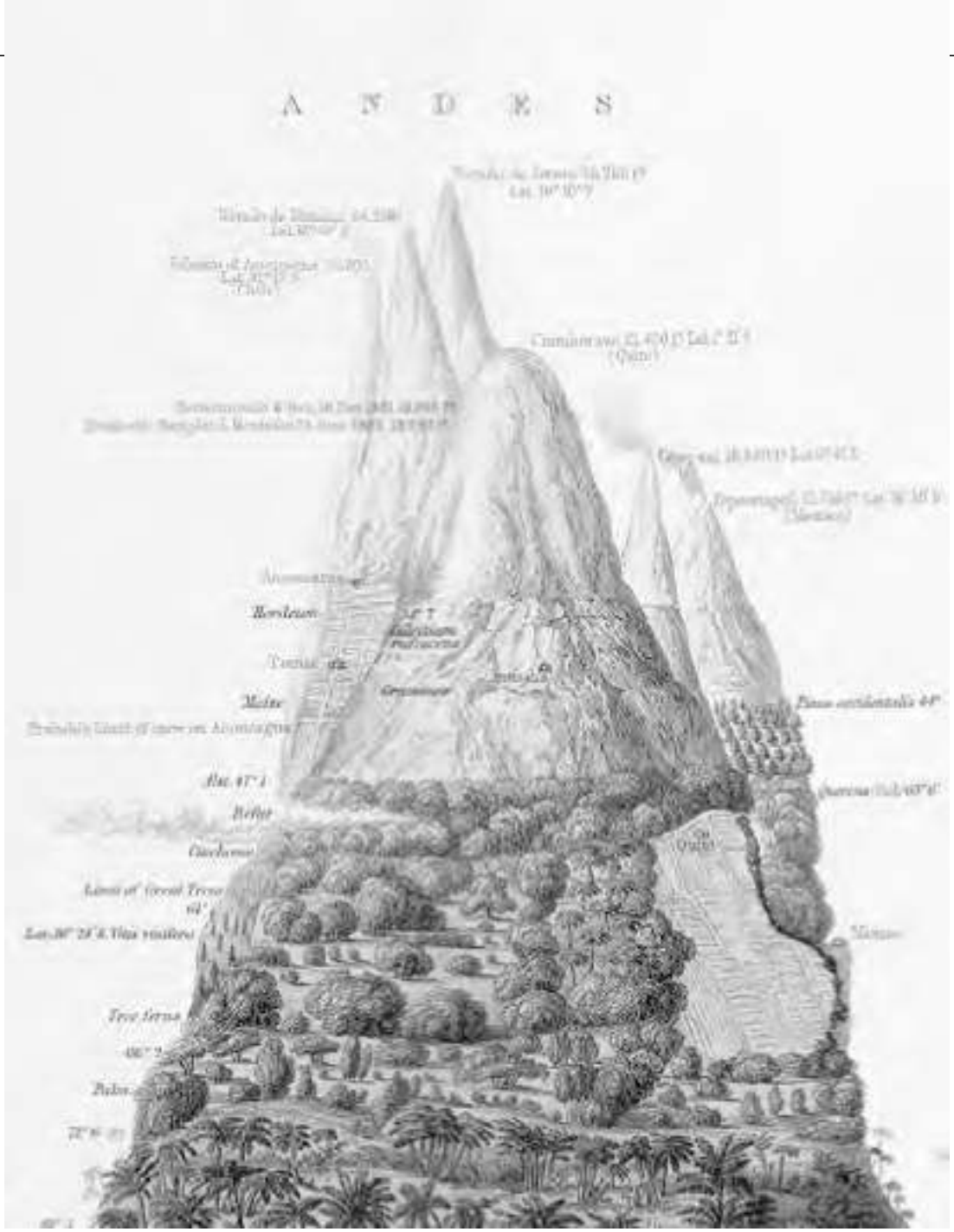
poor man. He could be vain, but would also give his last money to a struggling young scientist. He packed h
life with travels and incessant work. He always wanted to experience something new and, as he said, ideall
'three things at the same time'.

Humboldt was celebrated for his knowledge and scientific thinking, yet he was no cerebral scholar. N
content in his study or among books, he threw himself into physical exertion, pushing his body to its limi
He ventured deep into the mysterious world of the rainforest in Venezuela and crawled along narrow roc
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
well. Of course nature had to be measured and analysed, but he also believed that a great part of our respon
to the natural world should be based on the senses and emotions. He wanted to excite a 'love of nature'. At
time when other scientists were searching for universal laws, Humboldt wrote that nature had to
experienced through feelings.

Humboldt was unlike anybody else because he was able to remember even the smallest details for years: th
shape of a leaf, the colour of soil, a temperature reading, the layering of a rock. This extraordinary memo
allowed him to compare the observations he had made all over the world several decades or thousands of mil
apart. Humboldt was able to 'run through the chain of all phenomena in the world at the same time', o
colleague later said. Where others had to ransack their memories, Humboldt – 'whose eyes are natur
telescopes & microscopes' as the American writer and poet Ralph Waldo Emerson said in admiration – ha
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 zon
were stacked one on top of the other. In the valleys, he had passed through palms and humid bamboo fores
where colourful orchids clung to the trees. Further up he had seen conifers, oaks, alders and shrub-li
berberis similar to those he knew from European forests. Then had come alpine plants much like those he ha
collected in the mountains in Switzerland and lichens that reminded him of specimens from the Arctic Circ
and Lapland. No one had looked at plants like this before. Humboldt saw them not through the narro
categories of classification but as types according to their location and climate. Here was a man who viewe
nature as a global force with corresponding climate zones across continents: a radical concept at the time, a
one that still colours our understanding of ecosystems.



The distribution of plants in the Andes (Illustration Credit prl.2)

Humboldt's books, diaries and letters reveal a visionary, a thinker far ahead of his time. He invente isotherms – the lines of temperature and pressure that we see on today's weather maps – and he also discovere the magnetic equator. He came up with the idea of vegetation and climate zones that snake across the glob Most important, though, Humboldt revolutionized the way we see the natural world. He found connectio everywhere. Nothing, not even the tiniest organism, was looked at on its own. 'In this great chain of caus and effects,' Humboldt said, 'no single fact can be considered in isolation.' With this insight, he invented th 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. one thread is pulled, the whole tapestry may unravel. After he saw the devastating environmental effects colonial plantations at Lake Valencia in Venezuela in 1800, Humboldt became the first scientist to talk abou harmful human-induced climate change. Deforestation there had made the land barren, water levels of t lake were falling and with the disappearance of brushwood torrential rains had washed away the soils on th

surrounding mountain slopes. Humboldt was the first to explain the forest's ability to enrich the atmosphe with moisture and its cooling effect, as well as its importance for water retention and protection against so erosion. He warned that humans were meddling with the climate and that this could have an unforeseeab impact on 'future generations'.

The Invention of Nature traces the invisible threads that connect us to this extraordinary man. Humbol influenced many of the greatest thinkers, artists and scientists of his day. Thomas Jefferson called him 'one the greatest ornaments of the age'. Charles Darwin wrote that 'nothing ever stimulated my zeal so much reading Humboldt's Personal Narrative,' saying that he would not have boarded the *Beagle*, nor conceived the *Origin of Species*, without Humboldt. William Wordsworth and Samuel Taylor Coleridge bo incorporated Humboldt's concept of nature into their poems. And America's most revered nature write Henry David Thoreau, found in Humboldt's books an answer to his dilemma on how to be a poet *and* naturalist – *Walden* would have been a very different book without Humboldt. Simón Bolívar, t revolutionary who liberated South America from Spanish colonial rule, called Humboldt the 'discoverer the New World' and Johann Wolfgang von Goethe, Germany's greatest poet, declared that spending a fe days with Humboldt was like 'having lived several years'.

On 14 September 1869, one hundred years after his birth, Alexander von Humboldt's centennial w celebrated across the world. There were parties in Europe, Africa and Australia as well as the Americas. Melbourne and Adelaide people came together to listen to speeches in honour of Humboldt, as did groups Buenos Aires and Mexico City. There were festivities in Moscow where Humboldt was called t 'Shakespeare of sciences', and in Alexandria in Egypt where guests partied under a sky illuminated wi fireworks. The greatest commemorations were in the United States, where from San Francisco Philadelphia, and from Chicago to Charleston, the nation saw street parades, sumptuous dinners and concer In Cleveland some 8,000 people took to the streets and in Syracuse another 15,000 joined a march that w more than a mile long. President Ulysses Grant attended the Humboldt celebrations in Pittsburgh togeth 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 enti houses had vanished behind huge posters bearing Humboldt's face. Even the ships sailing by, out on th Hudson River, were garlanded in colourful bunting. In the morning thousands of people followed ten mus bands, marching from the Bowery and along Broadway to Central Park to honour a man 'whose fame nation can claim' as the *New York Times*'s front page reported. By early afternoon, 25,000 onlookers ha assembled in Central Park to listen to the speeches as a large bronze bust of Humboldt was unveiled. In t evening as darkness settled, a torchlight procession of 15,000 people set out along the streets, walking benea colourful Chinese lanterns.

Let us imagine him, one speaker said, 'as standing on the Andes' with his mind soaring above all. Ever speech across the world emphasized that Humboldt had seen an 'inner correlation' between all aspects nature. In Boston, Emerson told the city's grandees that Humboldt was 'one of those wonders of the worl His fame, the *Daily News* in London reported, was 'in some sort bound up with the universe itself'. Germany there were festivities in Cologne, Hamburg, Dresden, Frankfurt and many other cities. The greate German celebrations were in Berlin, Humboldt's hometown, where despite torrential rain 80,000 peop assembled. The authorities had ordered offices and all government agencies to close for the day. As the rai 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 vo Humboldt's ideas still shape our thinking. And while his books collect dust in libraries, his name linge

everywhere from the Humboldt Current running along the coast of Chile and Peru to dozens of monumen parks and mountains in Latin America including Sierra Humboldt in Mexico and Pico Humboldt Venezuela. A town in Argentina, a river in Brazil, a geyser in Ecuador and a bay in Colombia – all are name after Humboldt. [1]

There are Kap Humboldt and Humboldt Glacier in Greenland, as well as mountain ranges in northe China, South Africa, New Zealand and Antarctica. There are rivers and waterfalls in Tasmania and Ne Zealand as well as parks in Germany and Rue Alexandre de Humboldt in Paris. In North America alone fou counties, thirteen towns, mountains, bays, lakes and a river are named after him, as well as the Humbol Redwoods State Park in California and Humboldt Parks in Chicago and Buffalo. The state of Nevada w almost called Humboldt when the Constitutional Convention debated its name in the 1860s. Almost 30 plants and more than 100 animals are named after him – including the Californian Humboldt lily (*Liliu humboldtii*), the South American Humboldt penguin (*Spheniscus humboldti*) and the fierce predatory six-fo Humboldt squid (*Dosidicus gigas*) which can be found in the Humboldt Current. Several minerals carry h 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 s unknowingly. Rachel Carson's *Silent Spring* is based on Humboldt's concept of interconnectedness, an scientist James Lovelock's famous Gaia theory of the earth as a living organism bears remarkable similariti When Humboldt described the earth as 'a natural whole animated and moved by inward forces', he pre-date Lovelock's ideas by more than 150 years. Humboldt called his book describing this new concept *Cosm* having initially considered (but then discarded) 'Gäa' as a title.

We are shaped by the past. Nicolaus Copernicus showed us our place in the universe, Isaac Newto explained the laws of nature, Thomas Jefferson gave us some of our concepts of liberty and democracy, an Charles Darwin proved that all species descend from common ancestors. These ideas define our relationship t 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 connectio through his ideas, and through the many people whom he inspired. Like a rope, Humboldt's concept of natu connects us to him.

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

In Quito, I held Humboldt's original Spanish passport in my hands – the very papers that allowed him t travel through Latin America. In Berlin, I finally understood how his mind worked when I opened the boxe that contained his notes – marvellous collages of thousands of bits of paper, sketches and numbers. Closer home, at the British Library in London, I spent many weeks reading Humboldt's published books, some s huge and heavy that I could scarcely lift them on to the table. In Cambridge I looked at Darwin's own copi of Humboldt's books – those that Darwin had kept on a shelf next to his hammock on the *Beagle*. They a filled with Darwin's pencil marks. Reading these books was like eavesdropping on Darwin talking t Humboldt.

I found myself lying at night in the Venezuelan rainforest listening to the strange bellowing cry of howl monkeys, but also stuck in Manhattan without electricity during Hurricane Sandy when I had travelled the

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 *Ma and Nature* in the early 1860s – a book inspired by Humboldt's ideas and one that would mark the beginnin 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 through a forest wilderness'.

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

The result of this exploration through landscapes and letters, through thoughts and diaries, is this book. *T Invention of Nature* is my quest to rediscover Humboldt, and to restore him to his rightful place in the panthec of nature and science. It's also a quest to understand why we think as we do today about the natural world.

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[1] To this day many German-speaking schools across Latin America hold biannual athletic competitions called *Juegos Humboldt* – Humboldt Gam

PART I

Departure: Emerging Ideas

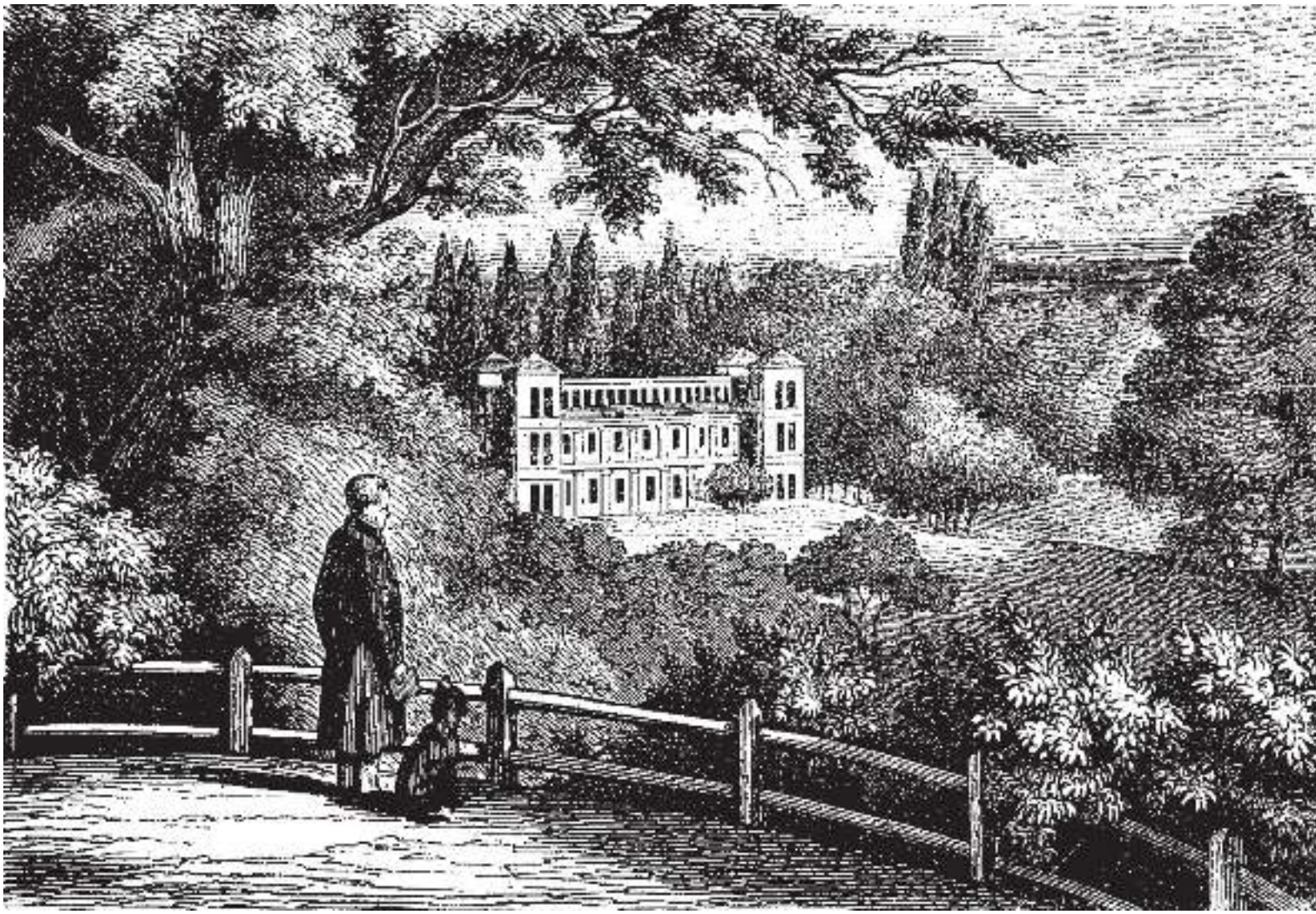
1

Beginnings

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

These were strange relationships in which the boys sometimes searched for a father figure. One tutor i particular, Gottlob Johann Christian Kunth, who oversaw their education for many years, taught them with peculiar combination of expressing displeasure and disappointment while at the same time encouraging a sen of dependency. Hovering behind them and watching over their shoulders as they calculated, translated Lati texts or learned French vocabulary, Kunth constantly corrected the brothers. He was never quite satisfie with their progress. Whenever they made a mistake, Kunth reacted as if they had done so to hurt or offen him. For the boys, this behaviour was more painful than if he had spanked them with a cane. Always despera 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 brothe despite being two years younger. The result was that he believed himself to be less talented. When Wilhel excelled in Latin and Greek, Alexander felt incompetent and slow. He struggled so much, Alexander later to a friend, that his tutors 'were doubtful whether even ordinary powers of intelligence would ever be develope in him'.



Schloss Tegel and the surrounding estate (Illustration Credit 1.1)

Wilhelm lost himself in Greek mythology and histories of ancient Rome, but Alexander felt restless wi books. Instead he escaped the classroom whenever he could to ramble through the countryside, collecting ar sketching plants, animals and rocks. When he returned with his pockets full of insects and plants his fami nicknamed him 'the little apothecary', but they didn't take his interests seriously. According to family lor one day the Prussian king, Frederick the Great, asked the boy if he planned to conquer the world like h 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 wh didn't understand him. His teachers were demanding and his mother lived withdrawn from society and he sons. Marie Elisabeth von Humboldt's greatest concern was, Kunth said, to foster the 'intellectual and mor perfection' of Wilhelm and Alexander – their emotional wellbeing was seemingly of no interest. 'I was force into a thousand constraints,' Humboldt said, and into loneliness, hiding behind a wall of pretence because never felt that he could be himself with his stern mother watching his every step. Expressions of excitement of joy were unacceptable behaviour in the Humboldt household.

Alexander and Wilhelm were very different. Where Alexander was adventurous and enjoyed bein outside, Wilhelm was serious and studious. Alexander was often torn between emotions, while Wilhelm overriding character trait was self-control. Both brothers withdrew into their own worlds – Wilhelm into h books and Alexander on lonely walks through Tegel's forests, great woods that had been planted wi imported North American trees. As he wandered among colourful sugar maples and stately white oak Alexander experienced nature as calming and soothing. But it was also among these trees from another wor