# Alexander von Humboldt: Scientist Extraordinaire

*Tom Niziol*

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*Portrait of Alexander von Humboldt by Friedrich Georg Weitsch, 1806. (Humboldt State University)*

We have all read about famous scientists who helped to shape and steer our knowledge of the world. Back in the 19th century, there were the likes of Charles Darwin, Louis Pasteur, Thomas Edison, Madame Curie, and many more whose contributions are well documented. Then there are those names that may have not made it into our grade school and high school history books. We may know them from other references, like a mountain or ocean current, such as the Humboldt Current off the coast of South America.

I never really thought about who this “Humboldt” was and what his contributions might have been. Coming

from Buffalo, New York, I was familiar with places like Humboldt Park and the beautiful tree-lined road that once crossed the city, known as Humboldt Parkway.

Decades flew by, until one day in 2016 I was listening to an interview with a historian and author, Andrea Wulf, who had just published a book titled *The Invention of Nature*. As I listened, I nearly jumped off my chair to hear about the amazing life of the 19th-century Prussian naturalist Alexander von Humboldt. In particular, I was fascinated with his connections to the science of meteorology and climatology.

It turns out that Humboldt was one of the world's most famous scientists of his era, and a thinker ahead of his time in many ways. As Laura Dassow Walls put it in an American Scientist review of *The Invention of Nature*, "How on earth did we ever lose sight of Alexander von Humboldt?"

# Bringing it together


*People pass by a billboard showing an image of Prussian explorer, geographer, and natural scientist Alexander von Humboldt at the entrance of the Humboldt University on April 3, 2019, in Berlin, Germany, as the nation commemorated the 250th anniversary of von Humboldt's birth. (Michele Tantussi/Getty Images)*

Science was beginning to advance more and more rapidly in the 19th century as technology, communication, education,

and the Industrial Revolution moved forward. These advances covered the full range of scientific disciplines, including the study of the weather and climate. Here in the U.S., the early 1800s brought a plethora of daily weather observations from all parts of the expanding nation. In Europe, manned and unmanned balloon flights were taking weather instruments to heights never measured before. Information on the weather and climate from locations around the world was being recorded.

But how could all of this information be shared? How could one tie it all together?

Enter Alexander von Humboldt, considered by many to be the father of modern geography and ecology. As Wulf noted in *The Invention of Nature*, he was “described by his contemporaries as the most famous man in the world behind Napoleon”. Praises from some of the most famous persons of the time were nearly endless. Thomas Jefferson called him “the most scientific man of his age”. Charles Darwin said that “nothing ever stimulated my zeal so much as reading Humboldt’s Personal Narrative,” going on to say that he would have never boarded the Beagle (his ship that toured the Galapagos) nor conceived of the Origin of the Species,

without Humboldt. Henry David Thoreau read Humboldt’s books and used them as a template to develop his ability to weave poetry and nature together. Years after Humboldt’s death, John Muir, America's most famous and influential naturalist and conservationist and founder of the Sierra Club, carried two of Humboldt’s most famous books with him wherever he journeyed, annotating passages throughout the works. Humboldt’s book *Views of Nature* even inspired the renowned science fiction writer Jules Verne in some of his greatest works.

In 1869, on the 100th anniversary of Humboldt’s birth, the world celebrated

this man like no other. In his home city of Berlin, 80,000 revelers braved a cold, stormy day. In New York, 25,000 were on hand as a large bronze bust of Humboldt was unveiled. In Boston, Ralph Waldo Emerson told celebrants that Humboldt was “one of the wonders of the world”.

According to *The Invention of Nature*, “more places are named after Humboldt than anyone else.” There’s of course the Humboldt Current that runs off the coast of South America, but also Humboldt Glacier in Greenland, mountain ranges on at least three continents, rivers, waterfalls and parks. In North America, there are 4 counties and 13 towns named

for him. Did you know that Humboldt was among the names proposed for Nevada during a state constitutional convention in 1864?

Humboldt was born in 1769 in Prussia and, during the course of his long life, set about to study nature on a scale as never before. What I love about Humboldt is that he was able to see Earth as one great organism where everything was connected. It was a bold new vision of nature that to this day influences the way in which we understand our natural world. It also connects the scientific thinking of his time with the views of many indigenous

cultures around the world that also see Earth as an interconnected system.

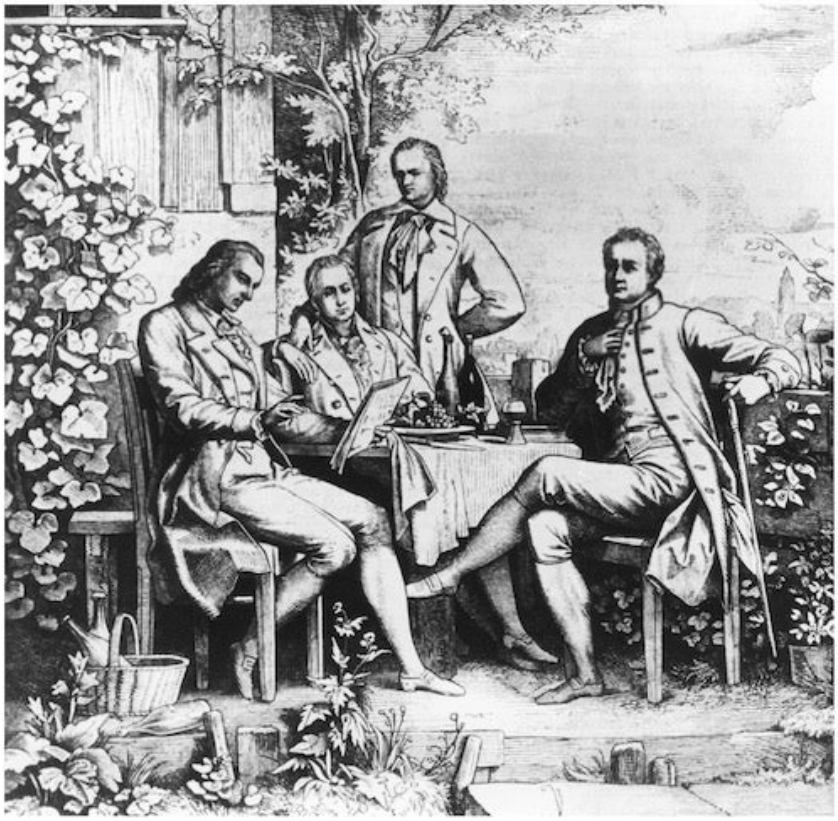
## An exploring spirit

As a young man, Humboldt became fascinated with scientific instruments, meticulously measuring and observing, but he was also driven by the sheer sense of wonder in all that was around him. Raised during a period of intellectual enlightenment in Europe, Humboldt had the good fortune as a young man to meet some of the greatest explorers and scientist of their age. He read the journals of Captain James Cook, who circumnavigated the globe, and on a visit to London he was able to meet and speak with Joseph Banks, the botanist for Cook's first voyage. In his

early 20s, Humboldt was in the right place at the right time again when he enrolled in the School of Mines at Freiberg, Germany. The academy taught the latest geological theories and was the home for a thriving scientific community with top students and professors from across Europe.

Through his brother Wilhelm, Humboldt met Germany's greatest poet of the time, Johann Wolfgang von Goethe, who also was a passionate scientist with a keen interest in everything from geology to botany. Over the course of several months working with Goethe, Humboldt continued to form his theories on how nature was connected. Humboldt was

the consummate scientist, believing in objectivity and taking the greatest strides to ensure the most accurate measurements and eventual generalization of results. Goethe, meanwhile, aligned himself with the observation process itself and the inevitable subjectivity in human perception and understanding. Humboldt eventually was able to draw from both perspectives. In fact, as author Wulf notes, “comparison became Humboldt’s primary means of understanding nature, not abstract mathematics or numbers”.



*A 1797 drawing by Ludwig Adrian Richter of a meeting in Jena, Prussia (now Germany) among Friedrich Schiller, Wilhelm von Humboldt, Alexander von Humboldt, and Johann Wolfgang Goethe. (Photo by ullstein bild via Getty Images)*

At a time when other scientists were searching for the universal laws of nature, Humboldt wrote that nature had to be experienced through feelings. He wanted to travel the world and experience nature in the most personal

way. He was uniquely gifted and well-prepared to accomplish this task.

Humboldt was known to have an extraordinary memory. He could remember the smallest details of the shape of a leaf, the color of a rock, a temperature reading from atop a mountain for years. His mind worked in all directions, and many people noted that when he spoke, he talked so fast that barely anybody could keep up with him. When he wrote, he would jot down notes on all margins of the page, when he ran out of room he would write on his desk, and as Andrea Wulf notes, “When he ran out of space, Humboldt used his large desk on which he carved

and scribbled ideas. Soon the entire table-top was completely covered with numbers, lines and words, so much so that a carpenter had to be called in to plane it clean again.”

After his parents died, Humboldt and his brother Wilhelm received a sizable inheritance that allowed him to live his dreams of exploring the world. In 1799, luck prevailed on him again, when King Carlos of Spain granted him a passport to explore the colonies of Latin America. Soon he was on his first expedition that framed the rest of his life. In a period of five years, it would change Humboldt from a curious and talented young man to the most

extraordinary scientist of his age. Here is where he would seek nature with both head and heart.

*Alexander von Humboldt along with his small team of explorers at the Cayambe volcano near Quito, Ecuador. (Wellcome Collection)*

In a letter to Karl Freiesleben in June of 1799, Humboldt stated “I shall endeavor to find out how nature's forces act upon one another, and in what manner the geographic environment exerts its

influence on animals and plants. In short, I must find out about the harmony in nature”. He set out from Spain with Aimé Bonpland, a French botanist who accompanied him throughout Latin America.

As would be expected by someone as meticulous as Humboldt, he was very prepared for his scientific journey. In a Weatherwise article on Humboldt, Stephen Vermette noted that Alexander took with him no less than 42 instruments ranging from “navigation and surveying to a microscope to observe small detail and to identify species, and instruments to measure magnetism”. His cache included two

mercurial barometers, several thermometers, a rain gauge, two hygrometers to measure humidity, a cyanometer to measure the blue color of the sky, a hypsometer which determines the temperature at which water boils at different altitudes and a eudiometer to measure the volume of gases. With those tools, he was able to compare observations he had made all over the world across decades and thousands of miles of exploration, allowing him to begin to interconnect nature on a world-wide scale.

As noted above, one of the most astonishing traits that characterized Humboldt was his amazing memory.

Whenever he picked up a plant, rock or insect, that brain was wired in a way that allowed his mind to race back to what he had seen in Europe years before and instantly make a comparison, allowing him to connect these observations across the globe.

Humboldt's South American expedition culminated in the ascent of Chimborazo, an extinct volcano that rose nearly 21,000 feet into the atmosphere. At that time, Chimborazo was considered by Europeans to be the highest mountain in the world. The harrowing climb almost took his life. As noted in The Invention of Nature, porters abandoned him and his team of scientists at 15,600 feet.

They continued on, experiencing nausea and dizziness with altitude sickness, bloodshot eyes, bleeding gums, and nearly constant vertigo. But despite these difficulties, Humboldt still had the energy to set up his instruments every few hundred feet of ascent, and with half-frozen hands was able to continue to take extremely accurate measurements of temperature and pressure among others. They made it to 19,413 feet—a higher elevation than any European had experienced before, even the continent's early balloonists.

When Humboldt reached that point and looked across the vista from Chimborazo, his amazing mind was able

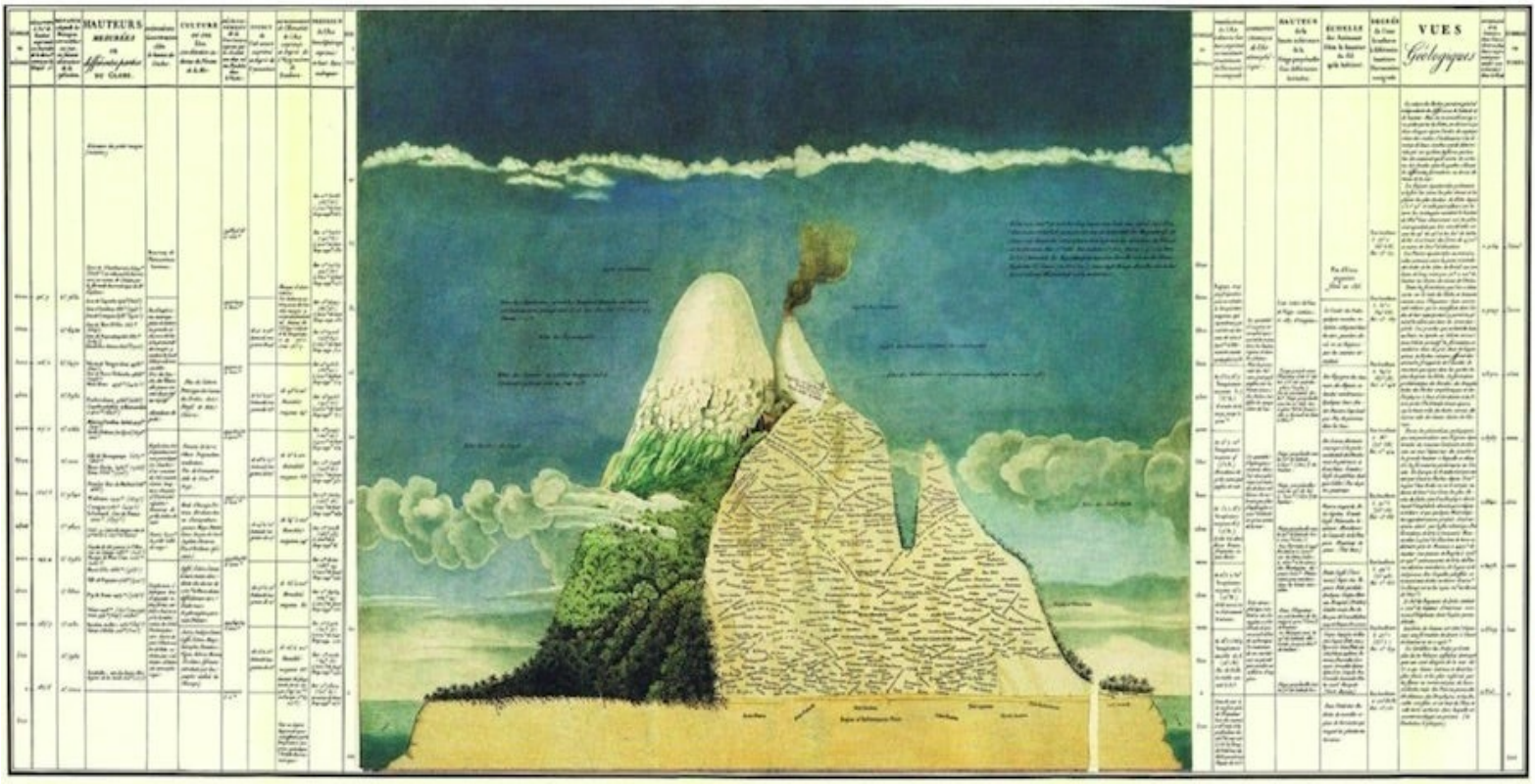
to trace back to all the plants, rocks, and measurements he had made on his journeys in Europe through the Alps and Pyrenees. At once everything he had ever observed fell into place. It was as if he could see nature as a “web of life”. This new idea of nature was to forever change the way in which people understood the natural world.

For Humboldt, the climb of Chimborazo had been like a botanical journey that moved from the equator to the poles, from tropical plants on the valleys to lichens at the tree line. At once, he saw all of nature laid out before him. He formulated that new vision into a single sketch that illustrated nature as a web

into which everything was connected. He called the sketch his Naturgemälde —in essence, “a painting of nature”.

For the first time in Western science, the Naturgemälde showed that nature was a globally connected force with corresponding climate zones across continents. As shown below, the extremely intricate sketch showed a mountain front and center, with several columns of writing on either side. By picking a particular height up the mountain in one column, one could trace across the mountain to other columns to see the temperature and atmospheric pressure, while at the same

time what species of animals and plants could be found at different elevations.

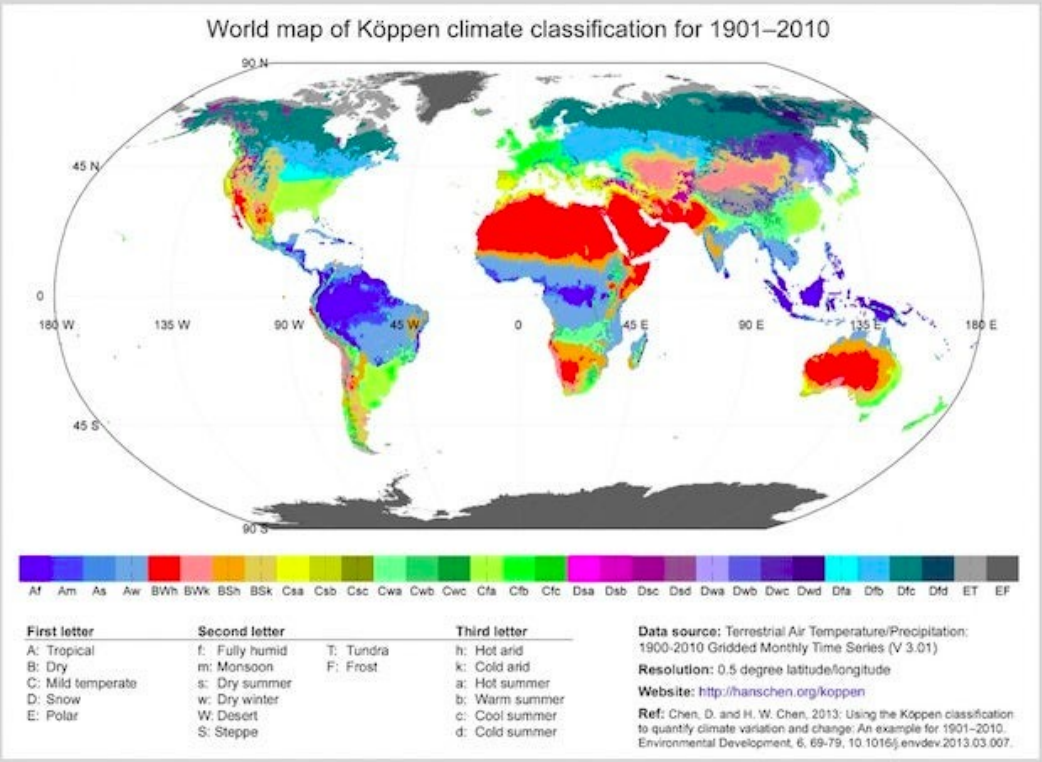



*Naturegemälde, "a painting of nature," was the exceptional illustration of years of observation and measurement, compiled into one chart that tied together the climate zones of the world.*

The temperature and pressure measurements recorded by Humboldt on his ascents were the first empirical evidence that linked decreasing temperatures to increasing altitude. This relationship allowed him to better

understand the link between climate and vegetation zones. As he put it, “The great elevation attained in several tropical countries, not only by single mountains but even extensive districts, enables the inhabitants of the torrid zone to behold also those vegetable forms which, demanding a cooler temperature, would seem to belong to other zones.”

Humboldt’s ability to relate the growth of vegetation to their surroundings essentially defined climate. This revelation was integral in the work of Wladimir Köppen (1846–1940), whose name is linked to the Köppen Climate Classification System that remains in common use today.




*Köppen climate classification system, building on the work of Humboldt.*

As a result of his journeys and expeditions, by 1817, at the age of 48, Humboldt had measured the weather in enough places to create a map that connected points of equal temperatures across the globe. This was the world's first isothermic map, a term coined by Humboldt (although not the first map of isolines ever produced; Edmund Halley, 1656–1742, is recognized as the first to

draw isolines). Humboldt's goal was to develop a better understanding of the global distribution of plant species. In his travels in South America, Humboldt was impressed by how similar species were between these New and Old Worlds, hypothesizing that temperature played a key role. This was a milestone in weather and climate analysis.

Humboldt noted, "Thus we see that circles of equal annual heat, or—to use a new term—isotherms, are not parallel to the equator but … they cut the geographic parallels under a variable angle slantwise." This was a revolutionary observation, since up to that time, the concept of "climate" was

essentially derived from the Greek word for inclination, which essentially coupled a location's climate to latitude.

On Humboldt's isothermal chart below (1817), you can clearly see that the lines of constant temperature are not strictly zonal (west-east), but rather dip over the North American continent and rise over the North Atlantic Ocean. This is essentially the first rendition of a map to show the how the temperature of continents differed from the coastal areas, running colder in the winters and warmer in the summers for the same latitude, a concept now known as continentality. The rise in the isotherms over the North Atlantic also reflects the

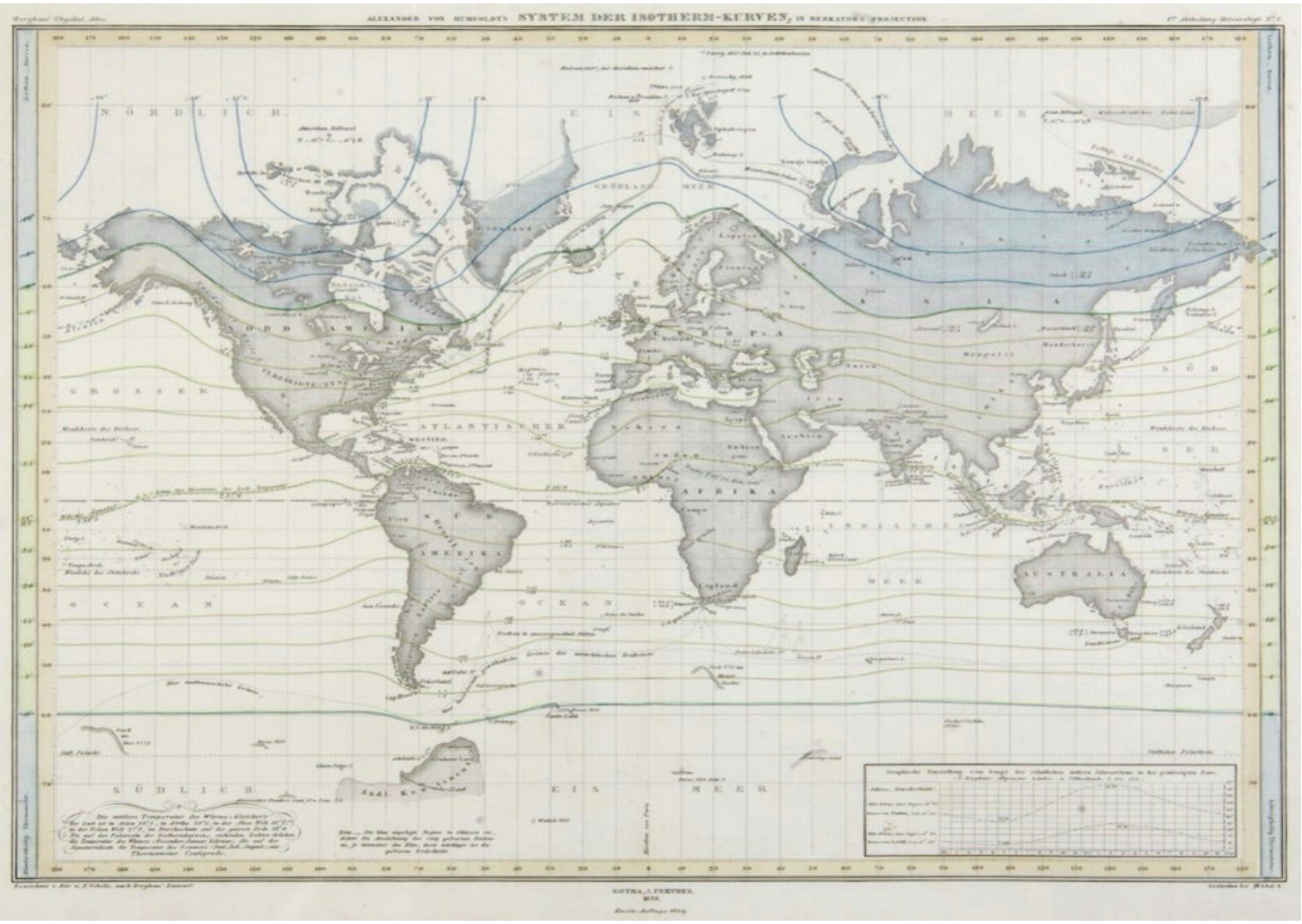
extension of the warm Gulf Stream, known as the North Atlantic Drift, toward the British Isles.

There was yet another connection that Humboldt discovered regarding ocean currents and climate, while sailing off the west coast of South America. In his measurements of the velocity and temperature of those waters, he discovered a cold ocean current—the Humboldt Current, as it is now called.

Finally, in the bottom right-hand corner of the figure below, he plots the temperature with altitude showing the relationship to both. As noted in Stephen Vermette's Weatherwise article, the discovery of that current eventually

provided the evidence and connection to explain the “aridity of coastal Peru and Ecuador: cooled air passing over the current limits precipitation. In short, Humboldt’s measurements and observations added three new climate controls—altitude, continentality, and ocean currents—to the one climate control (latitude)” that had been the rule up until that time.

# Humboldt's expanding vision




*Isoothermal chart (1817) showing the dip in the isotherms over the North American continent and rise over the North Atlantic Ocean. (OpenEdition Journals)*

Humboldt was considered one of the first scientists to tie together the concept of human-induced climate change. As noted in *The Invention of Nature*, "he

was the first to explain the fundamental functions of the forest for the ecosystem and climate: the trees' ability to store water and enrich the atmosphere with moisture, the protection of the soil, and their cooling effect." He discussed the impacts of trees on climate through the release of oxygen, noting the effect of the human species intervention was already "incalculable", insisting that it could become catastrophic if they continued to disturb the world so "brutally".

Humboldt's writing was not limited to science. He also spoke out against the brutality of slavery, at a time when it was widespread. After he had returned

to Europe, in 1810, Humboldt wrote a book titled *Political Essay on the Island of Cuba*. In this book, he called slavery "possibly the greatest evil ever to have afflicted humanity" and proposed setting aside public funds to buy slaves their freedom. As noted by Anna Maria Gillis in the NEH journal Humanities, "Humboldt's ideas so infuriated officials in Havana that they banned his book."

The culmination of Humboldt's journeys and knowledge was his multi-volume book series entitled Cosmos. The first volume, which he published at the age of 76 in 1845, was unlike any previous book on nature. Unlike other scientists, he did not write about one

topic. Rather he tied all of nature, from outer space to the inner core of the planet, together. Wulf notes that “where other scientists focused only on meteorological data such as temperature and weather, Humboldt was the first to understand climate as a system of complex correlations between the atmosphere, oceans and landmasses.” Cosmos sold over 20,000 copies in German in its first couple months. Two years later, another 40,000 copies in English sold, many of those to U.S. readers, establishing him as a household name across North America.

*Alexander von Humboldt in his library, 1856. (Fine Art Images/Heritage Images/Getty Images)*

Humboldt was the consummate Renaissance man. In addition to his amazing journeys to remote parts of the globe, he shaped the way in which we all view nature today. He was able to tie it all together and treat the world as one interconnected ecosystem. He had a

wonderful curiosity and treated nature as something you live and experience with all of your senses. I encourage you to explore much more about Humboldt's life and legacy, starting with the book I have already read twice: *The Invention of Nature*.

# About the author: Tom Niziol

Tom Niziol recently retired as winter weather expert for the Weather Channel after a 32-year career as a forecaster, science and operations officer, and meteorologist-in-charge at the National Weather Service office in Buffalo, NY. Tom has published several papers and taught forecasters around the world through the COMET Program. His keenest winter weather interest is lake-effect snow.

Source:
https://www.wunderground.com/cat6/alexander-von-humboldt-scientist-extraordinaire