EVOLUTION OF GEOGRAPHICAL THOUGHT

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Alexander von Humboldt

Friedrich Wilhelm Heinrich Alexander von Humboldt (14September 1769 – 6 May 1859) was a Prussian polymath, geographer, naturalist, explorer, and proponent of Romantic philosophy and science. He was the younger brother of the Prussian minister, philosopher, and linguist Wilhelm von Humboldt (1767–1835). Humboldt's quantitative work on botanical geography laid the foundation for the field of biogeography. Humboldt's advocacy of long-term systematic geophysical measurement laid the foundation for modern geomagnetic and meteorological monitoring. Between 1799 and 1804, Humboldt travelled extensively in the Americas, exploring and describing them for the first time from a modern scientific point of view. His description of the journey was written up and published in an enormous set of volumes over 21 years. Humboldt was one of the first people to propose that the lands bordering the Atlantic Ocean were once joined (South America and Africa in particular). Humboldt resurrected the use of the word *cosmos* from the ancient Greek and assigned it to his multivolume treatise, *Cosmos*, in which he sought to unify diverse branches of scientific knowledge and culture. This important work also motivated a holistic perception of the universe as one interacting entity. He was the first person to describe the phenomenon and cause of human-induced climate change, in 1800 and again in 1831, based on observations generated during his travels.

Early life and education

Alexander von Humboldt was born in Berlin in Prussia on 14 September 1769. He was baptized as a baby in the Lutheran faith, with the Duke of Brunswick serving as godfather. Humboldt's father, Alexander Georg von Humboldt, belonged to a prominent Pomeranian family. Although not one of the titled gentry, he was a major in the Prussian Army, who had served with the Duke of Brunswick. At age 42, Alexander Georg was rewarded for his services in the Seven Years' War with the post of royal chamberlain. He profited from the contract to lease state lotteries and tobacco sales. He first married the daughter of Prussian General Adjutant Schneider. In 1766, Alexander Georg married Maria Elisabeth Colombo, a well-educated woman and widow of Baron Hollowed, with whom she had a son. Alexander Georg and Maria Elisabeth had three children, a daughter, who died young, and then two sons, Wilhelm and Alexander. Her first-born son, Wilhelm

and Alexander's half-brother, was something of a ne'er do well, not often mentioned in the family history. Alexander Georg died in 1779, leaving the brothers Humboldt in the care of their emotionally distant mother. She had high ambitions for Alexander and his older brother Wilhelm, hiring excellent tutors, who were Enlightenment thinkers, including Kantian physician Marcus Herz and botanist Karl Ludwig Willdenow, who became one of the most important botanists in Germany. Humboldt's mother expected them to become civil servants of the Prussian state. The money Baron Holwede left to Alexander's mother became, after her death, instrumental in funding Alexander's explorations, contributing more than 70% of his private income. Due to his youthful penchant for collecting and labeling plants, shells, and insects, Alexander received the playful title of "the little apothecary". Marked for a political career, Alexander studied finance for six months in 1787 at the University of Frankfurt (Oder), which his mother might have chosen less for its academic excellence than its closeness to their home in Berlin. On 25 April 1789, he matriculated at the University of Göttingen, then known for the lectures of C. G. Heyne and anatomist J. F. Blumenbach. His brother Wilhelm was already a student at Gottingen, but they did not interact much, since their intellectual interests were quite different. His vast and varied interests were by this time fully developed. At Gottingen, he met Georg Forster, a naturalist who had been with Captain James Cook on his second voyage. Humboldt traveled with Forster in Europe. The two traveled to England, Humboldt's first sea voyage, the Netherlands, and France. In England, he met Sir Joseph Banks, president of the Royal Society, who had traveled with Captain Cook; Banks showed Humboldt his huge herbarium, with specimens of the South Sea tropics. The scientific friendship between Banks and Humboldt lasted until Banks's death in 1820, and the two shared botanical specimens for study. Banks also mobilized his scientific contacts in later years to aid Humboldt's work. Humboldt's scientific excursion up the Rhine resulted in his 1790 treatise *Mineralogische Beobachtungen über einige Basalte am Rhein* (Brunswick, 1790) (*Mineralogic Observations on Several Basalts on the River Rhine*). Humboldt's passion for travel was of long standing. Humboldt's talents were devoted to the purpose of preparing himself as a scientific explorer. With this emphasis, he studied commerce and foreign languages at Hamburg, geology at Freiberg School of Mines in 1791 under A.G. Werner, leader of the Neptunist school of geology; from anatomy at Jena under J.C. Loder; and astronomy and the use of scientific instruments under F.X. von Zach and J.G. Köhler. At Freiberg, he met a number of men who were to prove important to him in his later career, including Spaniard Manuel del Rio, who became director of the School of Mines the crown established in Mexico; Christian Leopold von Buch, who became a regional geologist; and, most importantly, Karl Freiesleben, who became tutor and close friend. During this period, his brother Wilhelm married,

but Alexander did not attend the nuptials. Humboldt graduated from the Freiberg School of Mines in 1792 and was appointed to a Prussian government position in the Department of Mines as an inspector in Bayreuth and the Fichtel mountains. Humboldt was excellent at his job, with production of gold ore in his first year outstripping the previous eight years. During his period as a mine inspector, Humboldt demonstrated his deep concern for the men laboring in the mines. He opened a free school for miners, paid for out of his own pocket, which became an unchartered government training school for labor. He also sought to establish an emergency relief fund for miners, aiding those following accidents. Humboldt's researches into the vegetation of the mines of Freiberg led to the publication in Latin (1793) of his *Florae Fribergensis, accedunt Aphorismi ex Doctrina, Physiologiae Chemicae Plantarum*, which was a compendium of his botanical researches. That publication brought him to the attention of Johann Wolfgang von Goethe, who had met Humboldt at the family home when Alexander was a boy, but Goethe was now interested in meeting the young scientist to discuss metamorphism of plants.[33] An introduction was arranged by Humboldt's brother, who lived in the university town of Jena, not far from Goethe. Goethe had developed his own extensive theories on comparative anatomy. Working before Darwin, he believed that animals had an internal force, an *urform*, that gave them a basic shape and then they were further adapted to their environment by an external force. Humboldt urged him to publish his theories. Together, the two discussed and expanded these ideas. Goethe and Humboldt soon became close friends. Humboldt often returned to Jena in the years that followed. Goethe remarked about Humboldt to friends that he had never met anyone so versatile. Humboldt's drive served as an inspiration for Goethe. In 1797, Humboldt returned to Jena for three months. During this time, Goethe moved from his residence in Weimar to reside in Jena. Together, Humboldt and Goethe attended university lectures on anatomy and conducted their own experiments. One experiment involved hooking up a frog leg to various metals. They found no effect until the moisture of Humboldt's breath triggered a reaction that caused the frog leg to leap off the table. Humboldt described this as one of his favorite experiments because it was as if he were "breathing life into" the leg. During this visit, a thunderstorm killed a farmer and his wife. Humboldt obtained their corpses and analyzed them in the anatomy tower of the university. In 1794, Humboldt was admitted to the famous group of intellectuals and cultural leaders of Weimar Classicism. Goethe and Schiller were the key figures at the time. Humboldt contributed (7 June 1795) to Schiller's new periodical, *Die Horen*, a philosophical allegory entitled *Die Lebenskraft, oder der rhodische Genius*.

Travels and work in Europe

In 1792 and 1797, Humboldt was in Vienna; in 1795 he made a geological and botanical tour through Switzerland and Italy. Although this service to the state was regarded by him as only an apprenticeship to the service of science, he fulfilled its duties with such conspicuous ability that not only did he rise rapidly to the highest post in his department, but he was also entrusted with several important diplomatic missions. Neither brother attended the funeral of their mother on 19 November 1796. Humboldt had not hidden his aversion to his mother, with one correspondent writing of him after her death, "her death... must be particularly welcomed by you". After severing his official connections, he awaited an opportunity to fulfill his longcherished dream of travel. Humboldt was able to spend more time on writing up his research. He had used his own body for experimentation on muscular irritability, recently discovered by Luigi Galvani and published his results, *Versuche über die gereizte Muskel- und Nervenfaser*(Berlin, 1797) (*Experiments on Stimulated Muscle and Nerve Fibres*), enriched in the French translation with notes by Blumenbach. With the financial resources to finance his scientific travels, he sought a ship on a major expedition. Meantime, he went to Paris, where his brother Wilhelm was now living. Paris was a great center of scientific learning and his brother and sister-in-law Caroline were well connected in those circles. Louis-Antoine de Bougainville urged Humboldt to accompany him on a major expedition, likely to last five years, but the French revolutionary Directoire placed Nicolas Baudin at the head of I rather than the aging scientific traveler.[37]On the postponement of Captain Baudin's proposed voyage of circumnavigation due to continuing warfare in Europe, which Humboldt had been officially invited to accompany, Humboldt was deeply disappointed. He had already selected scientific instruments for his voyage. He did, however, have a stroke of luck with meeting Aimé Bonpland, the botanist and physician for the voyage. Discouraged, the two left Paris for Marseilles, where they hoped to join Napoleon Bonaparte in Egypt, but North Africans were in revolt against the French invasion in Egypt and French authorities refused permission to travel. Humboldt and Bonpland eventually found their way to Madrid, where their luck changed spectacularly.

Spanish American expedition, 1799–1804

Seeking a foreign expedition

Spanish royal authorization, 1799

In Madrid, Humboldt sought authorization to travel to Spain's realms in the Americas; he was aided in obtaining it by the German representative of Saxony at the royal Bourbon court. Baron Forell had an interest in mineralogy and science endeavors and was inclined to help Humboldt. At that time, the Bourbon Reforms sought to reform administration of the realms and revitalize their economies. At the same time, the Spanish Enlightenment was in florescence. For Humboldt "the

confluent effect of the Bourbon revolution in government and the Spanish Enlightenment had created ideal conditions for his venture".The Bourbon monarchy had already authorized and funded expeditions, with the Botanical Expedition to the Viceroyalty of Peru to Chile and Peru (1777–88), New Granada (1783–1816), New Spain (Mexico) (1787–1803), and the Malaspina Expedition (1789–94). These were lengthy, state-sponsored enterprises to gather information about plants and animals from the Spanish realms, assess economic possibilities, and provide plants and seeds for the Royal Botanical Garden in Madrid (founded 1755). These expeditions took naturalists and artists, who created visual images as well as careful written observations as well as collecting seeds and plants themselves.[42] Crown officials as early as 1779 issued and systematically distributed *Instructions concerning the most secure and economic means to transport live plants by land and sea from the most distant countries*, with illustrations, including one for the crates to transport seeds and plants. When Humboldt requested authorization from the crown to travel to Spanish America, most importantly, with his own financing, it was given positive response. Spain under the Habsburg monarchy had guarded its realms against foreigner travelers and intruders. The Bourbon monarch was open to Humboldt's proposal. Spanish Foreign Minister Don Mariano Luis de Urquijo received the formal proposal and Humboldt was presented to the monarch in March 1799. Humboldt was granted access to crown officials and written documentation on Spain's empire. With Humboldt's experience working for the absolutist Prussian monarchy as a government mining official, Humboldt had both the academic training and experience of working well within a bureaucratic structure. Before leaving Madrid in 1799, Humboldt and Bonpland visited the Natural History Museum, which held results of Martín de Sessé y Lacasta and José Mariano Mociño's botanical expedition to New Spain. Humboldt and Bonpland met Hipólito Ruiz López and José Antonio Pavón y Jiménez of the royal expedition to Peru and Chile in person in Madrid and examined their botanical collections Armed with authorization from the King of Spain, Humboldt and Bonpland made haste to sail, taking the ship *Pizarro* from A Coruña, on 5 June 1799. The ship stopped six days on the island of Tenerife, where Humboldt climbed the volcano Teide, and then sailed on to the New World, landing at Cumaná, Venezuela, on 16 July.

Venezuela, 1799–1800

The ship's destination was not originally Cumaná, but an outbreak of typhoid on board meant that the captain changed course from Havana to land in northern South America. Humboldt had not mapped out a specific plan of exploration, so that the change did not upend a fixed itinerary. He later wrote that the diversion to Venezuela made possible his explorations along the Orinoco River to the border of Portuguese Brazil. With the diversion, the *Pizarro* encountered two large dugout

canoes each carrying 18 Guayaqui Indians. The *Pizarro*'s captain accepted the offer of one of them to serve as pilot. Humboldt hired this Indian, named Carlos del Pino, as a guide. Venezuela from the 16th to the 18th centuries was a relative backwater compared to the seats of the Spanish viceroyalties based in New Spain (Mexico) and Peru, but during the Bourbon reforms, the northern portion of Spanish South America was reorganized administratively, with the 1777 establishment of a captaincy-general based at Caracas. A great deal of information on the new jurisdiction had already been compiled by François de Pons, but was not published until 1806. Rather than describe the administrative center of Caracas, Humboldt started his researches with the valley of Aragua, where export crops of sugar, coffee, cacao, and cotton were cultivated. Cacao plantations were the most profitable, as world demand for chocolate rose.[48]Humboldt visited the mission at Caripe and explored the Guácharo cavern, where he found the oilbird, which he was to make known to science as *Steatornis caripensis*. Also described the Guanoco asphalt lake as "The spring of the good priest" ("*Quelle des guten Priesters*").[49][50] Returning to Cumaná, Humboldt observed, on the night of 11–12 November, a remarkable meteor shower (the Leonids). He proceeded with Bonpland to Caracas where he climbed the Avila mount with the young poet Andrés Bello, the former tutor of Simón Bolívar, who later became the leader of independence in northern South America. Humboldt met the Venezuelan Bolívar himself in 1804 in Paris and spent time with him in Rome. The documentary record does not support the supposition that Humboldt inspired Bolívar to participate in the struggle for independence, but it does indicate Bolívar's admiration for Humboldt's production of new knowledge on Spanish America. In February 1800, Humboldt and Bonpland left the coast with the purpose of exploring the course of the Orinoco River and its tributaries. This trip, which lasted four months and covered 1,725 miles (2,776 km) of wild and largely uninhabited country, had an aim of establishing the existence of the Casiquiare canal (a communication between the water systems of the rivers Orinoco and Amazon). Although, unbeknownst to Humboldt, this existence had been established decades before, his expedition had the important results of determining the exact position of the bifurcation,[18] and documenting the life of several native tribes such as the Maipures and their extinct rivals the Atures (several words of the latter tribe were transferred to Humboldt by one parrot. Around 19 March 1800, Humboldt and Bonpland discovered dangerous electric eels, whose shock could kill a man. To catch them, locals suggested they drive wild horses into the river, which brought the eels out from the river mud, and resulted in a violent confrontation of eels and horses, some of which died. Humboldt and Bonpland captured and dissected some eels, which retained their ability to shock; both received potentially dangerous electric shocks during their investigations. The encounter made Humboldt think

more deeply about electricity and magnetism, typical of his ability to extrapolate from an observation to more general principles. Humboldt returned to the incident in several of his later writings, including his travelogue *Personal Narrative* (1814–29), *Views of Nature* (1807), and *Aspects of Nature* (1849). Two months later, they explored the territory of the Maypures and that of the then-recently extinct Aturès Indians. Humboldt laid to rest the persistent myth of Walter Raleigh's Lake Parime by proposing that the seasonal flooding of the Rupununi savannah had been misidentified as a lake. On 24 November 1800, the two friends set sail for Cuba, landing on 19 December, where they met fellow botanist and plant collector John Fraser. Fraser and his son had been shipwrecked off the Cuban coast, and did not have a license to be in the Spanish Indies. Humboldt, who was already in Cuba, interceded with crown officials in Havana, as well as giving them money and clothing. Fraserobtained permission to remain in Cuba and explore. Humboldt entrusted Fraser with taking two cases of Humboldt and Bonpland's botanical specimens to England when he returned, for eventual conveyance to the German botanist Willdenow in Berlin. Humboldt and Bonpland stayed in Cuba until 5 March 1801, when they left for the mainland of northern South America again, arriving there on 30 March. Humboldt is considered to be the "second discoverer of Cuba" due to the scientific and social research he conducted on this Spanish colony. During an initial three-month stay at Havana, his first tasks were to properly survey that city and the nearby towns of Guanabacoa, Regla, and Bejucal. He befriended Cuban landowner and thinker Francisco de Arango y Parreño; together they visited the *Guines* area in south Havana, the valleys of Matanzas Province, and the Valley of the Sugar Mills in Trinidad. Those three areas were, at the time, the first frontier of sugar production in the island. During those trips, Humboldt collected statistical information on Cuba's population, production, technology and trade, and with Arango, made suggestions for enhancing them. He predicted that the agricultural and commercial potential of Cuba was huge and could be vastlyimproved with proper leadership in the future. On their way back to Europe from Mexico on their way to the United States, Humboldt and Bonpland stopped again in Cuba, leaving from the port of Veracruz and arriving in Cuba on 7 January 1804, staying until 29 April 1804. In Cuba, he collected plant material and made extensive notes. During this time, he socialized with his scientific and landowner friends, conducted mineralogical surveys, and finished his vast collection of the island's flora and fauna that he eventually published as *Essai politique sur l'îsle de Cuba*.

Cuba, 1800, 1804

The Andes, 1801–1803

After their first stay in Cuba of three months, they returned to the mainland at Cartagena de Indias (now in Colombia), a major center of trade in northern South

America. Ascending the swollen stream of the Magdalena River to Honda, they arrived in Bogotá on 6 July 1801, where they met the Spanish botanist José Celestino Mutis, head of the Royal Botanical Expedition to New Granada, staying there until 8 September 1801. Mutis was generous with his time and gave Humboldt access to the huge pictorial record he had compiled since 1783. Mutis was based in Bogotá, but as with other Spanish expeditions, he had access to local knowledge and a workshop of artists, who created highly accurate and detailed images. This type of careful recording meant that even if specimens were not available to study at a distance, "because the images traveled, the botanists did not have to".[61] Humboldt was astounded at Mutis's accomplishment; when Humboldt published his first volume on botany, he dedicated it to Mutis "as a simply mark of our admiration and acknowledgement".[Humboldt had hopes of connecting with the French sailing expedition of Baudin, now finally underway, so Bonpland and Humboldt hurried to Ecuador. They crossed the frozen ridges of the Cordillera Real, they reached Quito on 6 January 1802, after a tedious and difficult journey. Their stay in Ecuador was marked by the ascent of Pichincha and their climb of Chimborazo, where Humboldt and his party reached an altitude of 19,286 feet (5,878 m). This was a world record at the time, but 1000 feet short of the summit. Humboldt's journey concluded with an expedition to the sources of the Amazon *en route* for Lima, Peru. At Callao, the main port for Peru, Humboldt observed the transit of Mercury on 9 November and studied the fertilizing properties of guano, rich in nitrogen, the subsequent introduction of which into Europe was due mainly to his writings.[18] Humboldt and Bonpland had not intended to go to New Spain, but when they were unable to join a voyage to the Pacific, they left the Ecuadorian port of Guayaquil and headed for Acapulco on Mexico's west coast. Even before Humboldt and Bonpland started on their way to New Spain's capital on Mexico's central plateau, Humboldt realized the captain of the vessel that brought them to Acapulco had reckoned its location incorrectly. Since Acapulco was the main west-coast port and the terminus of the Asian trade from the Spanish Philippines, having accurate maps of its location was extremely important. Humboldt set up his instruments, surveying the deep-water bay of Acapulco, to determine its longitude.

New Spain (Mexico), 1803–1804

Humboldt and Bonpland landed in Acapulco on 15 February 1803, and from there they went to Taxco, a silver-mining town in modern Guerrero. In April 1803, he visited Cuernavaca, Morelos. Impressed by its climate, he nicknamed the city the *City of Eternal Spring*. Humboldt and Bonpland arrived in Mexico City, having been officially welcomed via a letter from the king's representative in New Spain, Viceroy Don José de Iturrigaray. Humboldt was also given a special passport to travel throughout New Spain and letters of introduction to intendants, the highest

officials in New Spain's administrative districts (intendancies). This official aid to Humboldt allowed him to have access to crown records, mines, landed estates, canals, and Mexican antiquities from the prehispanic era. Humboldt read the writings of Bishop-elect of the important diocese of Michoacan Manuel Abad y Queipo, a classical liberal, that were directed to the crown for the improvement of New Spain.[70] They spent the year in the viceroyalty, traveling to different Mexican cities in the central plateau and the northern mining region. The first journey was from Acapulco to Mexico City, through what is now the Mexican state of Guerrero. The route was suitable only for mule train, and all along the way, Humboldt took measurements of elevation. When he left Mexico a year later in 1804, from the east coast port of Veracruz, he took a similar set of measures, which resulted in a chart in the *Political Essay*, the physical plan of Mexico with the dangers of the road from Acapulco to Mexico City, and from Mexico City to Veracruz.[71] This visual depiction of elevation was part of Humboldt's general insistence that the data he collected be presented in a way more easily understood than statistical charts. A great deal of his success in gaining a more general readership for his works was his understanding that "anything that has to do with extent or quantity can be represented geometrically. Statistical projections [charts and graphs], which speak to the senses without tiring the intellect have the advantage of bringing to a large number of important facts".[72]Humboldt was impressed with Mexico City, which at the time was the largest city in the Americas, and one that could be counted as modern. He declared "no city of the new continent, without even excepting those of the United States, can display such great and solid scientific establishments as the capital of Mexico".[73] He pointed to the Royal College of Mines, the Royal Botanical Garden and the Royal Academy of San Carlos as exemplars of a metropolitan capital in touch with the latest developments on the continent and insisting on its modernity.[74] He also recognized important creole savants in Mexico, including José Antonio de Alzate y Ramírez, who died in 1799, just before Humboldt's visit; Miguel Velásquez de León; and Antonio de León y Gama.

Humboldt spent time at the Valenciana silver mine in Guanajuato, central New Spain, at the time the most important in the Spanish empire. The bicentennial of his visit in Guanajuato was celebrated with a conference at the University of Guanajuato, with Mexican academics highlighting various aspects of his impact on the city. Humboldt could have simply examined the geology of the fabulously rich mine, but he took the opportunity to study the entire mining complex as well as analyze mining statistics of its output. His report on silver mining is a major contribution, and considered the strongest and best informed section of his *Political Essay*. Although Humboldt was himself a trained geologist and mining inspector, he drew on mining experts in Mexico. One was Fausto Elhuyar, then

head of the General Mining Court in Mexico City, who, like Humboldt was trained in Freiberg. Another was Andrés Manuel del Río, director of Royal College of Mines, whom Humboldt knew when they were both students in Freiberg. The Bourbon monarchs had established the mining court and the college to elevate mining as a profession, since revenues from silver constituted the crown's largest source of income. Humboldt also consulted other German mining experts, who were already in Mexico.While Humboldt was a welcome foreign scientist and mining expert, the Spanish crown had established fertile ground for Humboldt's investigations into mining. Spanish America's ancient civilizations were a source of interest for Humboldt, who included images of Mexican manuscripts (or codices) and Inca ruins in his richly illustrated *Vues des cordillères et monuments des peuples indigènes de l'Amerique* (1810–1813), the most experimental of Humboldt's= publications, since it does not have "a single ordering principle" but his opinions and contentions based on observation.[78] For Humboldt, a key question was the influence of climate on the development of these civilizations.[79] When he published his *Vues des cordillères,* he included a color image of the Aztec calendar stone, which had been discovered buried in the main plaza of Mexico City in 1790, along with select drawings of the Dresden codex and others he sought out later in European collections. His aim was to muster evidence that these pictorial and sculptural images could allow the of prehispanic history. He sought out Mexican experts in the interpretation of sources from there, especially Antonio Pichardo, who was the literary executor of Antonio de León y Gama's work. For American-born Spaniards (creoles) who were seeking sources of pride in Mexico's ancient past, Humboldt's recognition of these ancient works and dissemination in his publications was a boon. He read the work of exiled Jesuit Francisco Javier Clavijero, which celebrated Mexico's prehispanic civilization, and which Humboldt invoked to counter the pejorative assertions about the new world by Buffon, de Pauw, and Raynal. Humboldt ultimately viewed both the prehispanic realms of Mexico and Peru as despotic and barbaric.[81] However, he also drew attention to indigenous monuments and artifacts as cultural productions that had "both ... historical *and* artistic significance".[82] One of his most widely read publications resulting from his travels and investigations in Spanish America was the *Essai politique sur le royaum de la Nouvelle Espagne,* quickly translated to English as *Political Essay on the Kingdom of New Spain* (1811).[83] This treatise was the result of Humboldt's owninvestigations as well as the generosity of Spanish colonial officials for statistical data.

Leaving from Cuba, Humboldt decided to take an unplanned short visit to the United States. Knowing that the current U.S. president, Thomas Jefferson, was himself a scientist, Humboldt wrote to him saying that he would be in the United States. Jefferson warmly replied, inviting him to visit the White House in the

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The United States, 1804

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After six weeks, Humboldt set sail for Europe from the mouth of the Delaware and landed at Bordeaux on 3 August 1804. Humboldt kept a detailed diary of his sojourn to Spanish America, running some 4,000 pages, which he drew on directly for his multiple publications following the expedition. The leather-bound diaries themselves are now in Germany, having been returned from Russia to East Germany, where they were taken by the Red Army after World War II. Following German reunification, the diaries were returned to a descendant of Humboldt. For a

time, there was concern about their being sold, but that was averted.[88] A government-funded project to digitize the Spanish American expedition as well as his later Russian expedition has been undertaken (2014–2017) by the University of Potsdam and the German State Library—Prussian Cultural Heritage Foundation.[89] Humboldt's decades' long endeavor to publish the results of this expedition not only resulted in multiple volumes, but also made his international reputation in scientific circles. Humboldt came to be wellknownwith the reading public as well, with popular, densely illustrated, condensed versions of his work

Travel diaries

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Achievements of the Latin American expedition

Humboldt's decades' long endeavor to publish the results of this expedition not only resulted in multiple volumes, but also made his international reputation in scientific circles. Humboldt came to be well known with the reading public as well, with popular, densely illustrated, condensed versions of his work in multiple languages. Bonpland, his fellow scientist and collaborator on the expedition, collected botanical specimens and preserved them, but unlike Humboldt who had a passion to publish, Bonpland had to be prodded to do the formal descriptions. Many scientific travelers and explorers produced hugevisual records, which remained unseen by the general public until the late nineteenth century, in the case of the Malaspina Expedition, and even the late twentieth century, when Mutis's botanical, some 12,000 drawings from New Granada, was published. Humboldt, by contrast, published immediately and continuously, using and ultimately exhausting his personal fortune, to produce both scientific and popular texts. Humboldt's name and fame were made by his travels to Spanish America, particularly his publication of the *Political Essay on the Kingdom of New Spain*. His image as the premier European scientist was a later development.[90] For the Bourbon crown, which had authorized the expedition, the returns were not only tremendous in terms of sheer volume of data on their New World realms, but in dispelling the vague and pejorative assessments of the New World by Guillaume-Thomas Raynal, Georges-Louis Leclerc, Comte de Buffon, and William Robertson. The achievements of the

Bourbon regime, especially in New Spain, were evident in the precise data Humboldt systematized and published.[70] This memorable expedition may be regarded as having laid the foundation of the sciences of physical geography, plant geography, and meteorology. Key to that was Humboldt's meticulous and systematic measurement of phenomena with the most advanced instruments then available. He closely observed plant and animal species in situ, not just in isolation, noting all elements in relation to one other. He collected specimens of plants and animals, dividing the growing collection so that if a portion was lost, other parts might survive. Humboldt saw the need for an approach to science that could account for the harmony of nature among the diversity of the physical world. For Humboldt, "the unity of nature" meant that it was the interrelation of all physical sciences—such as the conjoining between biology, meteorology and geology—that determined where specific plants grew. He found these relationships by unraveling myriad, painstakingly collected data,[91] data extensive enough that it became an enduring foundation upon which others could base their work. Humboldt viewed nature holistically, and tried to explain natural phenomena without the appeal to religious dogma. He believed in the central importance of observation, and as a consequence had amassed a vast array of the most sophisticated scientific instruments then available. Each had its own velvet lined box and was the most accurate and portable of its time; nothing quantifiable escaped measurement. According to Humboldt, everything should be measured with the finest and most modern instruments and sophisticated techniques available, for that collected data was the basis of all scientific understanding.

This quantitative methodology would become known as Humboldtian science. Humboldt wrote "Nature herself is sublimely eloquent. The stars as they sparkle in firmament fill us with delight and ecstasy, and yet they all move in orbit marked out with mathematical precision."[92] His *Essay on the Geography of Plants* (published first in French and then German, both in 1807) was based on the then novel idea of studying the distribution of organic life as affected by varying physical conditions.[18] This was most famously depicted in his published cross-section of Chimborazo, approximately two feet by three feet (54 cm x 84 cm) color pictorial, he called *Ein Naturgemälde der Anden* and what is also called the Chimborazo Map. It was a fold-out at the back of the publication.[94] Humboldt first sketched the map when he was in South America, which included written descriptions on either side of the cross-section of Chimborazo. These detailed the information on temperature, altitude, humidity, atmosphere pressure, and the animal and plants (with their scientific names) found at each elevation. Plants from the same genus appear at different elevations. The depiction is on an east-west axis going from the Pacific coast lowlands to the Andean range of which Chimborazo was a part, and the eastern Amazonian basin. Humboldt showed the three zones of

coast, mountains, and Amazonia, based on his own observations, but he also drew on existing Spanish sources, particularly Pedro Cieza de León, which he explicitly referred to. The Spanish American scientist Francisco José de Caldas had also measured and observed mountain environments and had earlier come to similar ideas about environmental factors in the distribution of life forms.[95] Humboldt was thus not putting forward something entirely new, but it is argued that his finding is not derivative either.[96] The Chimborazo map displayed complex information in an accessible fashion. The map was the basis for comparison with other major peaks. "The Naturgemälde showed for the first time that nature was a global force with corresponding climate zones across continents."[97] Another assessment of the map is that it "marked the beginning of a new era of environmental science, not only of mountain ecology but also of global-scale biogeophysical patterns and processes."[98] By his delineation (in 1817) of isothermal lines, he at once suggested the idea and devised the means of comparing the climatic conditions of various countries. He first investigated the rate of decrease in mean temperature with the increase in elevation above sea level, and afforded, by his inquiries regarding the origin of tropical storms, the earliest clue to the detection of the more complicated law governing atmospheric disturbances in higher latitudes.[18][99] This was a major contribution to climatology.[100][101] His discovery of the decrease in intensity of Earth's magnetic field from the poles to the equator was communicated to the Paris Institute in a memoir read by him on 7 December 1804. Its importance was attested by the speedy emergence of rival claims.[18] His services to geology were based on his attentive study of the volcanoes of the Andes and Mexico, which he observed and sketched, climbed, and measured with a variety of instruments. By climbing Chimborazo, he established an altitude record which became the basis for measurement of other volcanoes in the Andes and the Himalayas. As with other aspects of his investigations, he developed methods to show his synthesized results visually, using the graphic method of geologic-cross sections.[102] He showed that volcanoes fell naturally into linear groups, presumably corresponding with vast subterranean fissures; and by his demonstration of the igneous origin of rocks previously held to be of aqueous formation, he contributed largely to the elimination of erroneous views, such as Neptunism.[18] Humboldt was a significant contributor to cartography, creating maps, particularly of New Spain, that became the template for later mapmakers in Mexico. His careful recording of latitude and longitude led to accurate maps of Mexico, the port of Acapulco, the port of Veracruz, and the Valley of Mexico, and a map showing trade patterns among continents. His maps also included schematic information on geography, converting areas of administrative districts (intendancies) using proportional squares.[103] The U.S. was keen to see his maps and statistics on New Spain, since

they had implication for territorial claims following the Louisiana Purchase.[104] Later in life, Humboldt published three volumes (1836–39) examining sources that dealt with the early voyages to the Americas, pursuing his interest in nautical astronomy in the fifteenth and sixteenth centuries. His research yielded the origin of the name "America", put on a map of the Americas by Martin Waldseemüller.[105]Humboldt conducted a census of the indigenous and European inhabitants in New Spain, publishing a schematized drawing of racial types and populations distribution, grouping them by region and social characteristics.[106] He estimated the population to be six million individuals.[107][108] He estimated Indians to be forty percent of New Spain's population, but their distribution being uneven; the most dense were in the center and south of Mexico, the least dense in the north. He presented these data in chart form, for easier understanding.[109] He also surveyed the non-Indian population, categorized as Whites (Spaniards), *Negroes*, and castes (*castas*).[110] American-born Spaniards, so-called *creoles* had been painting depictions of mixed-race family groupings in the eighteenth century, showing father of one racial category, mother of another, and the offspring in a third category in hierarchical order, so racial hierarchy was an essential way elites viewed Mexican society.

Humboldt reported that American-born Spaniards were legally racial equals of those born in Spain, but the crown policy since the Bourbons took the Spanish throne privileged those born in Iberia. Humboldt observed that "the most miserable European, without education and without intellectual cultivation, thinks himself superior to whites born in the new continent".[112] The truth in this assertion, and the conclusions derived from them, have been often disputed as superficial, or politically motivated, by some authors, considering that between 40% and 60% of high offices in the new world were held by creoles.[113][114] The enmity between some creoles and the peninsular-born whites increasingly became an issue in the late period of Spanish rule, with creoles increasingly alienated from the crown. Humboldt's assessment was that royal government abuses and the example of a new model of rule in the United States were eroding the unity of whites in New Spain.[115] Humboldt'swritings on race in New Spain were shaped by the memorials of the classical liberal, enlightened Bishop-elect of Michoacán, Manuel Abad y Queipo, who personally presented Humboldt with his printed memorials to the Spanish crown critiquing social and economic conditions and his recommendations for eliminating them.[116][114] One scholar says that his writings contain fantastical descriptions of America, while leaving out its inhabitants, stating that Humboldt, coming from the Romantic school of thought, believed '... nature is perfect till man deforms it with care'.[117] The further assessment is that he largely neglected the human societies amidst nature. Views of indigenous peoples as 'savage' or 'unimportant' leaves them out of the historical

picture.[117] Other scholars counter that Humboldt dedicated large parts of his work todescribing the conditions of slaves, indigenous peoples, mixed-race castas, and society in general. He often showed his disgust for the slavery[118] and inhumane conditions in which indigenous peoples and others were treated and he often criticized Spanish colonial policies.[119]

Humboldt was not primarily an artist, but he could draw well, allowing him to record a visual record of particular places and their natural environment. Many of his drawings became the basis for illustrations of his many scientific and general publications. Artists whom Humboldt influenced, such as Johann Moritz Rugendas, followed in his path and painted the same places Humboldt had visited and recorded, such as the basalt formations in Mexico, which was an illustration in his *Vues des Cordillères*.[120][121] The editing and publication of the encyclopedic mass of scientific, political and archaeological material that had been collected by him during his absence from Europe was now Humboldt's most urgent desire. After a short trip to Italy with Joseph Louis Gay-Lussac for the purpose of investigating the law of magnetic declination and a stay of two and a half years in Berlin, in the spring of 1808, he settled in Paris. His purpose for being located there was to secure the scientific cooperation required for bringing his great work through the press. This colossal task, which he at first hoped would occupy but two years, eventually cost him twenty-one, and even then it remained incomplete.

During his lifetime Humboldt became one of the most famous men in Europe.[122] Academies, both native and foreign, were eager to elect him to their membership, the first being The American Philosophical Society in Philadelphia, which he visited at the tail end of his travel through the Americas. He was elected to the Prussian Academy of Sciences in 1805.[123] Over the years other learned societies in the U.S. elected him a member, including the American Antiquarian Society (Worcester, MA) in 1816;[124] the Linnean Society of London in 1818; the New York Historical Society in 1820; a Foreign Honorary Member of the American Academy of Arts and Sciences in 1822.;[125] the American Ethnological Society (New York) in 1843; and the American Geographical and Statistical Society, (New York) in 1856.[126] He was elected a foreign member of the Royal Swedish Academy of Sciences in 1810. The Royal Society, whose president Sir Joseph Banks had aided Humboldt as a young man, now welcomed him as a foreign member.[127]

Expedition in Russia, 1829

Adolphe Polier, one of Humboldt's friends from Paris; a cook; plus a contingent of Cossacks for security. Three carriages were filled with people, supplies, and scientific instruments. For Humboldt's magnetic readings to be accurate, they carried an iron-free tent.[140] This expedition was unlike his Spanish American travels with Bonpland, with the two alone and sometimes accompanied by local

guides. The Russian government was interested in Humboldt finding prospects for mining and commercial advancement of the realm and made it clear that Humboldt was not to investigate social issues, nor criticize social conditions of Russian serfs. In his publications on Spanish America, he did comment on the conditions of the indigenous populations, and deplored black slavery, but well after he had left those territories.[141] As Humboldt discovered, the government kept tight control of the expedition, even when it was 1,000 miles (1,600 km) from Moscow, with local government officials greeting the expedition at every stop. The itinerary was planned with Tobolsk the farthest destination, then a return to St Petersburg. Humboldt wrote to the Russian Minister Cancrin that he was extending his travel, knowing that the missive would not reach him in time to scuttle the plan. The further east he journeyed into wilder territory, the more Humboldt enjoyed it. They still followed the Siberian Highway and made excellent progress, sometimes a hundred miles (160 km) in a day.[142] Although they were halted at the end of July and warned of an anthrax outbreak, Humboldt decided to continue despite the danger. "At my age, nothing should be postponed".[143] The journey though carried out with all the advantages afforded by the immediate patronage of the Russian government, was too rapid to be profitable scientifically. The correction of the prevalent exaggerated estimate of the height of the Central Asian plateau, and the prediction of the discovery of diamonds in the gold-washings of the Urals, were important aspects of these travels. In the end, the expedition took 8 months, traveled 15,500 km, stopped at 658 post stations, and used 12,244 horses.[144] One writer claims that "Nothing was quite as Humboldt wanted it. The entire expedition was a compromise."[145] The Russian emperor offered Humboldt an invitation to return to Russia, but Humboldt declined, due to his disapproval of Nicholas's restrictions on his freedom of movement during the expedition and his ability to freely report on it.[146] Humboldt published two works on the Russian expedition, first *Fragments de géologie et de climatologie asiatiques* in 1831, based on lectures he gave on the topic. In 1843, he completed the three-volume *Asie Centrale*,[147] which he dedicated to Czar Nicholas, which he called "an unavoidable step, as the expedition was accomplished at his expense".[148] As of 2016, these works have not been translated to English.[149] His 1829 expedition to Russia when he was an old man is much less known than his five-year travels in Spanish America, which had resulted in many published volumes over the decades since his 1804 return. Nevertheless, it gave Humboldt comparative data for his various later scientific publications. *Kosmos* was Humboldt's multi-volume effort in his later years to write a work bringing together all the research from his long career. The writing took shape in lectures he delivered before the University of Berlin in the winter of 1827–28. These lectures would form "the cartoon for the

great fresco of the *[K]osmos*".[150] His 1829 expedition to Russia supplied him with data comparative to his Latin American expedition.[151]

Publications

Cosmos

The first two volumes of the *Kosmos* were published between the years 1845 and 1847 were intended to comprise the entire work, but Humboldt published three more volumes, one of which was posthumous. Humboldt had long aimed to write a comprehensive work about geography and the natural sciences. The work attempted to unify the sciences then known in a Kantian framework. With inspiration from German Romanticism, Humboldt sought to create a compendium of the world's environment.[11] He spent the last decade of his long life—as he called them, his "improbable" years—continuing this work. The third and fourth volumes were published in 1850–58; a fragment of a fifth appeared posthumously in 1862. His reputation had long since been made with his publications on the Latin American expedition. There is not a consensus on the importance of *Kosmos*. One scholar, who stresses the importance of Humboldt's *Political Essay on the Kingdom of New Spain* as essential reading, dismisses *Kosmos* as "little more than an academic curiosity".[152] A different opinion is that *Kosmos* was his "most influential book".[151] As with most of Humboldt's works, *Kosmos* was also translated into multiple languages in editions of uneven quality. It was very popular in Britain and America. In 1849 a German newspaper commented that in England two of the three different translations were made by women, "while in Germany most of the men do not understand it".[153] The first translation by Augustin Pritchard—published anonymously by Mr. Baillière (volume I in 1845 and volume II in 1848)—suffered from being hurriedly made. In a letter Humboldt said of it: "It will damage my reputation. All the charm of my description is destroyed by an English sounding like Sanskrit."

The other two translations were made by Elizabeth Juliana Leeves Sabine under the superintendence of her husband Col. Edward Sabine (4 volumes 1846–1858), and by Elise Otté (5 volumes 1849–1858, the only complete translation of the 4 German volumes). These three translations were also published in the United States. The numbering of the volumes differs between the German and the English editions. Volume 3 of the German edition corresponds to the volumes 3 and 4 of the English translation, as the German volume appeared in 2 parts in 1850 and 1851. Volume 5 of the German edition was not translated until 1981, again by a woman.[154] Otté's translation benefited from a detailed table of contents, and an index for every volume; of the German edition only volumes 4 and 5 had (extremely short) tables of contents, and the index to the whole work only appeared with volume 5 in 1862. Less well known in Germany is the atlas belonging to the German edition of the Cosmos *"Berghaus' Physikalischer Atlas"*,

better known as the pirated version by Traugott Bromme under the title *"Atlas zu Alexander von Humboldt's Kosmos"* (Stuttgart 1861). In Britain, Heinrich Berghaus planned to publish together with Alexander Keith Johnston a *"Physical Atlas"*. But later Johnston published it alone under the title *"The Physical Atlas of Natural Phenomena"*. In Britain its connection to the *Cosmos* seems not have been recognized.[155]

Alexander von Humboldt published prolifically throughout his life. Many works were published originally in French or German, then translated to other languages, sometimes with competing translation editions. Humboldt himself did not keep track of all the various editions.[156] He wrote specialized works on particular topics of botany, zoology, astronomy, mineralogy, among others, but he also wrote general works that attracted a wide readership, especially his *Personal Narrative of Travels*

Personal life

Much of Humboldt's private life remains a mystery because he destroyed his private letters. While a gregarious personality, he may have harbored a sense of social alienation, which drove his passion for escape through travel.[197]

Humboldt never married: while he was charmed by a number of attractive women, including Henriette, the wife of his mentor Marcus Herz, his sister-in-law Caroline von Humboldt stated "nothing will ever have a great influence on Alexander that doesn't come through men".[198] He had many strong male friendships, and at times had romances with men.[199] As a student he became infatuated with Wilhelm Gabriel Wegener, a theology student, penning a succession of letters expressing his "fervent love".[200] At 25 he met Reinhardt von Haeften (19 May 1772 – 20 October 1803), a 21-year-old lieutenant, with whom he lived and travelled for two years, and to whom he wrote in 1794: "I only live through you, my good precious Reinhardt". When von Haeften became engaged, Humboldt begged to remain living with him and his wife: "Even if you must refuse me, treat me coldly with disdain, I should still want to be with you... the love I have for you is not just friendship or brotherly love, it isveneration".[201]

A traveling companion in the Americas for five years was Aimé Bonpland, and in Quito in 1802 he met the Ecuadorian aristocrat Don Carlos Montúfar, who traveled with Humboldt to Europe and lived with him. In France, Humboldt traveled and lived with the physicist and balloonist Joseph Louis Gay Lussac. Later he had a deep friendship with the married French astronomer François Arago, whom he met daily for 15 years. Humboldt once wrote "I don't know sensual needs".[198] However, a pious travelling companion, Francisco José de Caldas, accused him of frequenting houses in Quito where "impure love reigned", of making friends with "obscene dissolute youths", of giving vent to "shameful passions of his heart", and dropping him to travel with "Bonpland and his Adonis"[Monúfar]. Humboldt

inherited a significant fortune, but the expense of his travels, and most especially of publishing (thirty volumes in all), had by 1834 made him totally reliant on the pension of King Frederick William III. Although he preferred living in Paris, by 1836 the King had insisted he return to
Germany. He lived with the Court at Sanssouci, and latterly in Berlin, with his valet Seifert, who had accompanied him to Russia in 1829.[205] Four years before his death, Humboldt executed a deed of gift transferring his entire estate to Seifert, who had by then married and set up a household near Humboldt's apartment.
Humboldt had become godfather to his daughter.[208] The scale of the bequest has always drawn speculation, especially as Seifert was some thirty years younger, and introducing lower class partners into households under the guise of servants was then a common practice.
In 1908, the sexual researcher Paul Näcke gathered reminiscences from homosexuals including Humboldt's friend the botanist Karl Bolle, then 90 years old: some of the material was incorporated by Magnus Hirschfeld into his 1914 study *Homosexuality in Men and Women*. However, speculations about Humboldt's private life and possible homosexuality continue to remain a fractious issue amongst scholars, particularly as earlier biographers had portrayed him as "a largely asexual, Christ-like Humboldt figure...suitable as a national idol".[

Illness and death

On 24 February 1857, Humboldt suffered a minor stroke, which passed without perceptible symptoms. It was not until the winter of 1858–1859 that his strength began to decline; on 6 May 1859, he died peacefully in Berlin, aged 89. His last words were reported to be "How glorious these sunbeams are! They seem to call Earth to the Heavens!"[214] His remains were conveyed in state through the streets of Berlin, in a hearse drawn by six horses. Royal chamberlains led the cortège, each charged with carrying a pillow with Humboldt's medals and other decorations of honor. Humboldt's extended family, descendants of his brother Wilhelm, walked in the procession. Humboldt's coffin was received by the prince-regent at the door of the cathedral. He was interred at the family resting-place at Tegel, alongside his brother Wilhelm and sister-in-law Caroline.