

Explorer of Mountains, Minerals, and Global Ecosystems: Alexander von Humboldt

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Alexander von Humboldt circa 1806. Photo of a painting by Friedrich Georg Weitsch at the Old National Gallery in Berlin, Germany. Public domain.

In a time of rapid climate change, earth scientists can learn from Alexander von Humboldt (1769–1859) as an immense contributor to geology and its complex of interacting spheres. His geological studies spanned decades and included minerals in mines, fossils and trace fossils, and erupting lava. Humboldt produced globally applicable maps by joining geological, botanical, and meteorological data that are invaluable to earth science and ecology. He is highly regarded because of his scientific expositions that resulted in publications, especially his magnum opus *Kosmos* (Cosmos, 1845), which incorporated myriad fields of study in his holistic view of nature.

Humboldt developed into a discoverer via his extensive excursions across Europe, into Asia, and to the Americas. For the latter, from 1799 to 1804, he documented a myriad of ecological zones via elevation and latitude changes, particularly focusing on plants. He also considered mineral associations, geomagnetism and gravity, mountain-building processes, volcanism, erosion of highlands, colonization of landscapes by plants, and defined global isotherms. Humboldt's notes and manuscripts, and particularly his *Cosmos*, serve as an invaluable baseline study for geologically instantaneous change brought on by humans.

Friedrich Wilhelm Heinrich Alexander, Freiherr (baron) von Humboldt, son of Alexander Georg von Humboldt and Maria Elizabeth Colomb, was born on 14 September 1769. From an early age he was influenced by his father and was collecting and cataloging treasures from the natural world. His father was an army officer who was part of a rich family with Pomeranian roots. Humboldt was baptized into the Lutheran faith, and his godfather, the Duke of Brunswick, was later to become King of Prussia.

Humboldt and his older brother Wilhelm became fatherless when they were 9 and 11 years old, respectively. It was their father who had the deepest emotional tie to his sons, and in contrast, their mother was somewhat aloof. She did provide them with good educations. Their tutors were “Enlightenment” thinkers, which aided development of intellectual prowess in the Humboldt brothers, but their pathways were somewhat different. Wilhelm (1767–1835) was to become widely known as the linguistically talented Prussian minister and philosopher, whereas Alexander gravitated to the world of natural science in “outdoor laboratories.” Humboldt, in comparison to his bibliophile brother, was restless and later conveyed to Carl Freisleben that tutors doubted “whether even ordinary powers of intelligence would ever be developed in him” (Bruhns, 1873, v. 1, p. 31; Biermann, 1987, p. 50).

The aristocratic Humboldt family spent winters in Berlin and summers in their country estate, Schloss Tegel, located about ten miles (16 km) northwest of central Berlin. The countryside was a proving ground for Humboldt as he filled his pockets with insects, shells, and plants. His family did not think anything would come of this budding naturalist, dubbing him “the little apothecary.” When Frederick the Great, the Prussian king, inquired of young Alexander if he was planning on a global conquest similar to his namesake, Alexander the Great, the youngster quipped “Yes, but with my head” (Walls, 2009, p. 15).

Humboldt's early years focused on nature, but his mother urged him to attend a university to become a civil servant. In 1787, he enrolled at the University of Frankfurt, studying finance courses in preparation for a political career. After six months, Humboldt moved on to Göttingen University where he studied natural science. While at Göttingen University, Humboldt was influenced by Georg Forster who sojourned with Captain Cook on his second voyage of discovery. Humboldt and Foster traveled throughout Europe, and in 1789 he had an opportunity to gaze upon the first-ever discovered fossil pterosaur skeleton. By 1790, Humboldt published *Mineralogical Observations of Some Basalts in the Rhine Basin*. His studies at Göttingen sparked further interests in mineralogy, so in 1791, Humboldt enrolled at the prestigious Freiberg School of Mines in Saxony. His mentor at Freiberg was Abraham Gottlob Werner (1749–1817). Under Werner's tutelage, Humboldt focused on minerals and mining. He worked underground in the mines by morning, took classes in the afternoon, and by evening he searched for plants to add to his collection.

The talented Humboldt prepared to become a scientific explorer by studying foreign languages and commerce at Hamburg, geology at Freiberg under Werner, anatomy at Jena under J.C. Loder, and astronomy and scientific instrumentation with F.X. von Zach and J.G. Köhler. He encountered several men at Freiberg who were important to his later career, including Andrés Manuel del Rio, who became director of the School of Mines established in Mexico and the discoverer of what would be called vanadium. Other Freiberg colleagues included Christian Leopold von Buch, a geologist who

defined the Jurassic and the *Kueper* or Upper Triassic, and Karl Freiesleben, who became Humboldt's tutor and close friend.

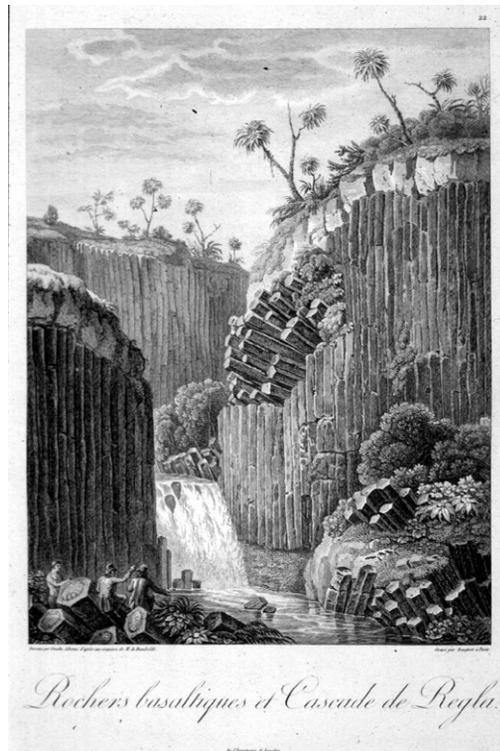
In 1792, Humboldt began working in Berlin as an assessor of mines. Here he continued his strong work ethic, being promoted and engaging in a number of diplomatic assignments. While he lived in Vienna from 1792–1797, he explored Italy and Switzerland. His descriptions of flora in the mines were published in *Florae Fribergensis Specimen* in 1793.

At age 27 Humboldt used his inheritance to begin his scientific expeditions. He first traveled with botanist Aime Bonpland (1773–1858) to Madrid to request special permission to explore South America. The king of Spain granted a permit and in the summer of 1799 he and Bonpland commenced their travels for five years in Central and South America, covering more than 6000 miles (9656 km) by foot, horseback, and by canoe. They climbed many mountain peaks, particularly near Quito, Ecuador, including most of the way up Chimborazo (20,702 feet or 6310 m)—standing for almost 30 years as the highest human ascent record. Humboldt's diary of Spanish America adventures, at over 4,000 pages, were seminal for his many published works, and he provided drawings such as of columnar basalts, mountains, and plants.

Some perhaps less known albeit important geology-related work of Humboldt beyond mines and minerals included his study of trace fossils such as the “hand-beast” footprint in Germany in 1833 (Knoll, 2009), vertebrate paleontology as is evidenced by his overseeing excavations near Bogota, Colombia (Bressen, 2014), and his assessment of manganese-dominated mineral coatings on rocks along cataracts of the Orinoco River that has been proven overall correct based on modern analytical results (Dorn et al., 2012). He also recognized the stratigraphic changes associated with rocks and coined the term “formation.” Furthermore, he surmised that there must have been extinction events associated with life on Earth, which was not well accepted at the time.

Upon completion of the Spanish America expedition in 1804, Humboldt visited the United States and President Thomas Jefferson. Humboldt then went to Paris, residing there for 23 years, until 1827, publishing about 30 volumes chronicling the expeditions of the Americas. In order to make a living, he secured an advising role for the King of Prussia. His last big excursion was in 1829 to Russia, where he was the first to find diamonds outside of the tropics and where he started investigating geomagnetism. He later documented mineral associations such as gold, platinum, and diamonds. After returning to Germany, he became famous for his speeches and began work on *Cosmos*, publishing the first volume in 1845.

The zest that Humboldt had for exploring the world's awesome wonders was inspirational for his contemporaries (e.g., Simon Bolivar, Charles Darwin) and his students (e.g., Louis Agassiz and father of organic chemistry Justus von Liebig) but also for earth scientists since his death. Due to his comprehensive approach to documenting natural systems, Humboldt was probably one of the most influential to document Earth's interacting spheres—bio,



Humboldt sketched this site in Mexico and published it in 1813. Public domain.

litho, hydro, and atmos—as this is paramount for us not only to praise Earth but to preserve it. His spirit lives on to inspire us all to understand and value these interconnections inherent in modern geological sciences.

FURTHER READING

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