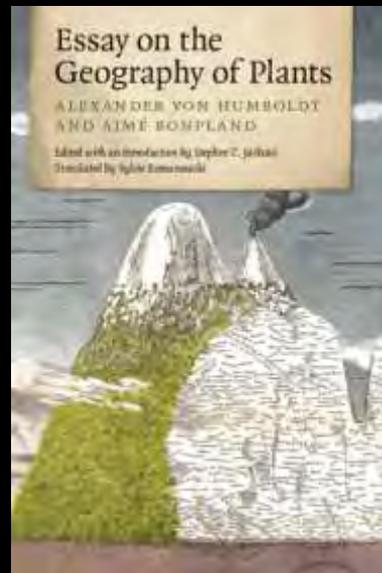
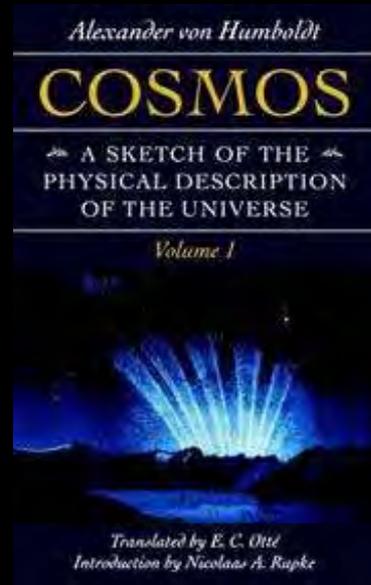
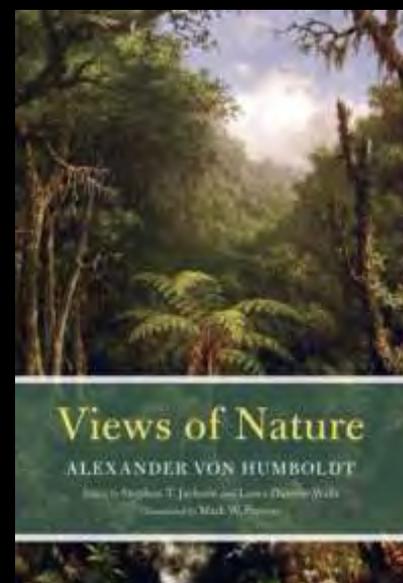
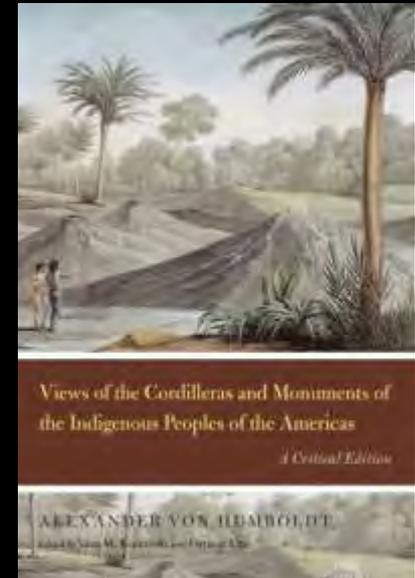


# The Scientist of Nature: Alexander Von Humboldt and the Physical Description of the Earth

Kevin M. Anderson Ph.D.

Austin Water Center for Environmental Research



In 1798, Alexander Von Humboldt was appointed by the King of Spain to make the first extensive scientific exploration of Spanish America.

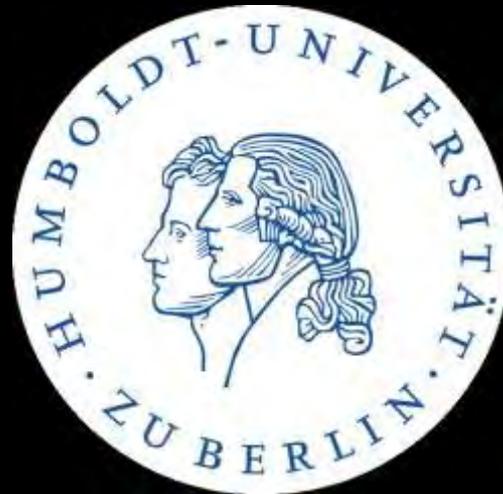
“I shall collect plants and fossils and make astronomic observations. But that’s not the main purpose of my expedition – I shall try to find out how the forces of nature interact upon one another and how the geographic environment influences plant and animal life. In other words, I must find out about the unity of nature.”



Humboldt's South American Expedition, 1799–1804  
Map by Alexander Karnstedt, Wikipedia Commons

## Alexander von Humboldt (14 September 1769 – 6 May 1859)

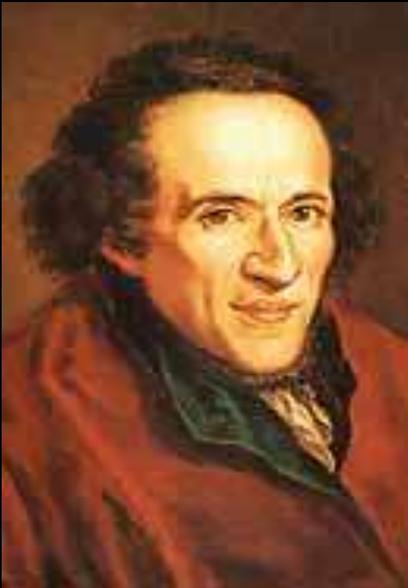
- Born in Berlin.
- His father was in the Prussian military, a confidant of the future king Friedrich Wilhelm II (who was Alexander's godfather) and set to be a minister, but died when Alexander was 9 and his brother, Wilhelm, was 11.
- His mother Maria Elisabeth was the daughter of a rich manufacturer and was described as distant and cold. She expected the boys to be successful and provided private tutors who were part of the Enlightenment culture of Berlin.
- Wilhelm von Humboldt (1767–1835) the Prussian diplomat and education reformer, philosopher, and linguist. Founder of the University of Berlin October 1810. In 1949, it changed its name to Humboldt University in honor of both its founder Wilhelm and his brother, Alexander.
- Hated the "von" and signed his name "Alexander Humboldt"





## Alexander Humboldt – youth and education

- The teenager “Young Apothecary” – nature as escape and redemption, talented artist
- 1785 attends lectures of Jewish physician Marcus Herz on physics and philosophy of Kant
- Becomes friends with Herz family, learns Hebrew, witnesses electrical experiments of Franklin and Volta
- Becomes friends with Moses Mendelssohn family (whose bank will later provide credit for 1799 journey)
- Adopts lifelong stance against anti-Semitism and for liberalization of laws restricting Jews in society
- 1787-8 studies botany and collects plants with Karl Ludwig Willdenow *Flora of Berlin*



# Historical and Intellectual Context and Influences

## The Unity of Nature

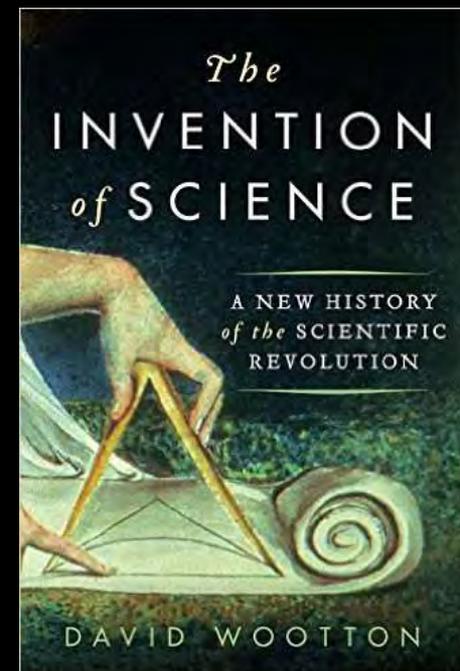
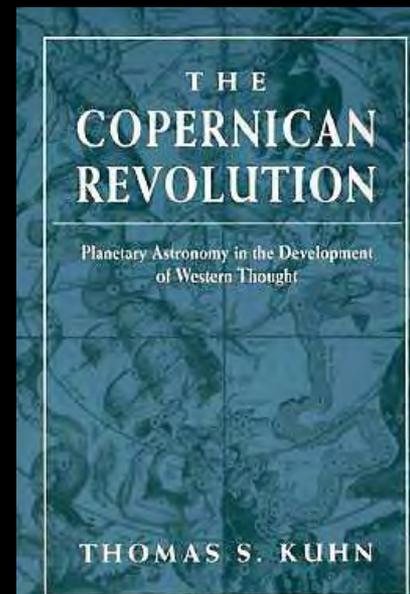
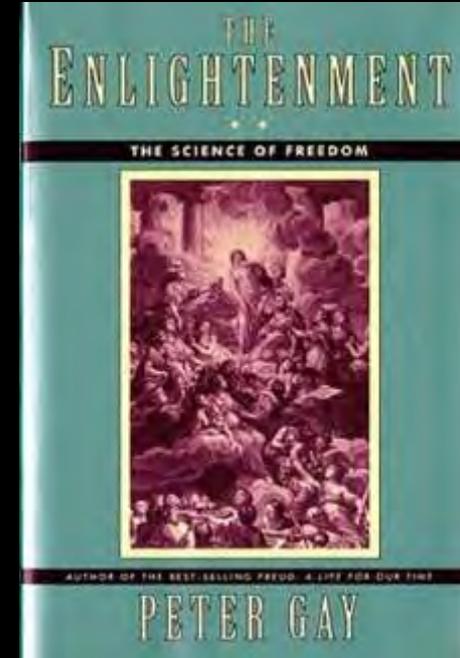
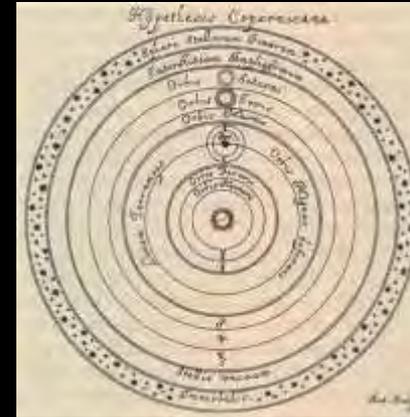


# The Scientific Revolution and the Enlightenment 1542-1800

- Dramatic revolutions in science, philosophy, society and politics swept away the medieval world-view
- Ideals of freedom and equality for all, founded, ostensibly, upon principles of human reason
- Begins with the Scientific Revolution (1542-1700) culminates historically in the political upheaval of the French Revolution 1789-99, in which the traditional hierarchical political and social orders were overthrown

The rise of the new science progressively undermines not only the ancient geocentric conception of the cosmos, but, with it, the entire set of presuppositions that had served to constrain and guide philosophical inquiry.

The dramatic success of the new science in explaining the natural world promotes this “natural philosophy” as an independent authority challenging the old theological philosophy and construct a new world view



# The Enlightenment

The major figures of the Enlightenment included Voltaire, Denis Diderot, Jean-Jacques Rousseau, David Hume, Edmund Burke, Adam Smith, Goethe, and Immanuel Kant.

Some European rulers, including Catherine II of Russia, Joseph II of Austria and Frederick II of Prussia, tried to apply Enlightenment thought on religious and political tolerance, which became known as enlightened absolutism.

The Americans Benjamin Franklin and Thomas Jefferson came to Europe during the period and the ideals of the Enlightenment were incorporated into the United States Declaration of Independence and the Constitution of the United States.



# The Conditions of Knowledge and Science

## Empiricism vs Rationalism

All knowledge from experience or All knowledge from reason?

## David Hume 1711-1776

Undercut the certainty of scientific inductive knowledge by showing that since we know only what our senses tell us, we really can know nothing at all (with certainty).

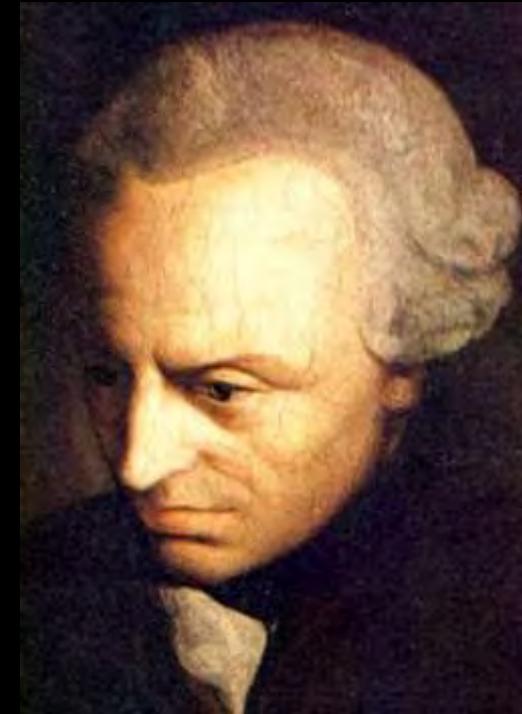
## Immanuel Kant 1724-1804

- Set out to create a synthesis of rationalism and empiricism
- Hume was right in one respect – we cannot know with absolute certainty anything outside our perceptions or experience – things in themselves.
- But we can know phenomenal reality – the world as it presents itself through our experience of it.
- Experience provides the content of our knowledge and reason provides the form - the independent world and the human mind are a unity.
- To know nature better is thus to know ourselves better, for knowledge is a deeply human project.



## Immanuel Kant and Physical Geography

- In his lectures on Physical Geography Kant expressed profound dissatisfaction with the system of classifying the natural world that had been devised by Linnaeus who named and classified plants according to a small number of features of their external structure.
- To Kant, a taxonomy produced by such a process was bound to be arbitrary. It was incapable of conveying “the idea of a whole out of which the manifold character of things is...derived”
- It did not convey the richness and complexity of natural phenomena, nor did it sufficiently emphasize the importance of integrative and unifying processes that were not directly visible.
- The essential prerequisite of a satisfactory form of natural science was a full description of phenomena as the actually occurred and coexisted in the world.
- The earth was one interconnected whole – but it was also conceived of as made up of different natural units, of regions.
- Regionalism in its strongest form became environmental determinism – the climate and environment of a particular region affected everything from the vegetation to the moral and intellectual properties of humans living there.
- Kant was a strong determinist and racist.



## University of Göttingen – Center of Scientific Scholarship

- He joins Wilhelm at the University of Göttingen 1789
- By the 1780s a distinctive school of natural philosophy developed at Göttingen embracing Kant's ideas of physical geography – holistic organization, effect of the total environment upon the organism, identify the recurring structural features that underlie the variety of plant and animal physiology – search for unity in the diversity of nature
- Studies anthropology, comparative anatomy, and natural history with Johann Friedrich Blumenbach – proponent of racial equality [contra Kant]
- Meets Georg Forster



## Georg Forster 1754-1794

a naturalist, ethnologist, travel writer, journalist, and revolutionary

- With his father, Johann Reinhold Forster (1729-98), he emigrated to England in 1766. Both were invited to accompany Capt. James Cook on his second voyage around the world (1772–75).
- Johann Reinhold Forster *Observations Made during a Voyage round the World*
- Georg Forster *A Voyage Towards the South Pole and Round the World* (1777)
- 
- Admitted to the Royal Society at the early age of twenty-two
- Meets Humboldt in 1789 when Humboldt studies at University of Göttingen
- Takes him for a journey March – July 1790 Netherlands, France, England – meets Joseph Banks
- Forster publishes account of the *journey Views of the Lower Rhine, Brabant, Flanders* (three volumes, 1791–94)



# Captain James Cook 1728 – 1779

First voyage (1768–71)  
Joseph Banks and Daniel Solander

Second voyage (1772–75)  
Johann Reinhold Forster and Georg Forster

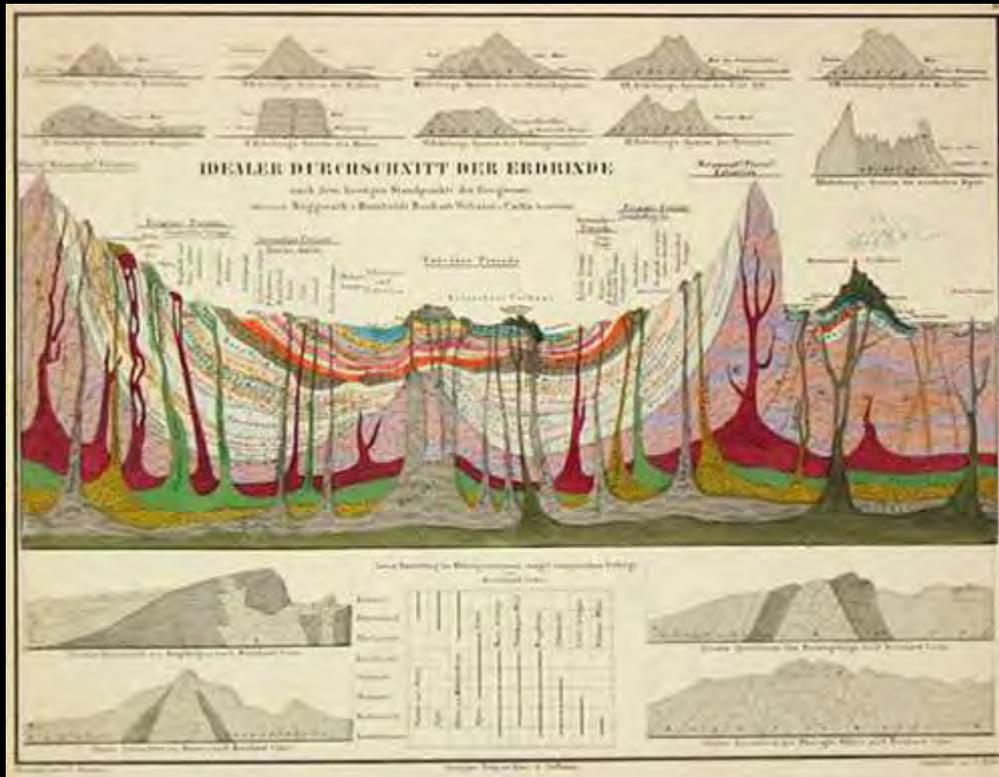
Third voyage (1776–79)  
Killed in Hawaii



## Geology 1791-96

- Geology at Freiberg in 1791 under Abraham Gottlob Werner, "father of German geology" leader
- 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

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 them following accidents.



Abraham Gottlob Werner

# Romanticism 1800-1859

## Romanticism

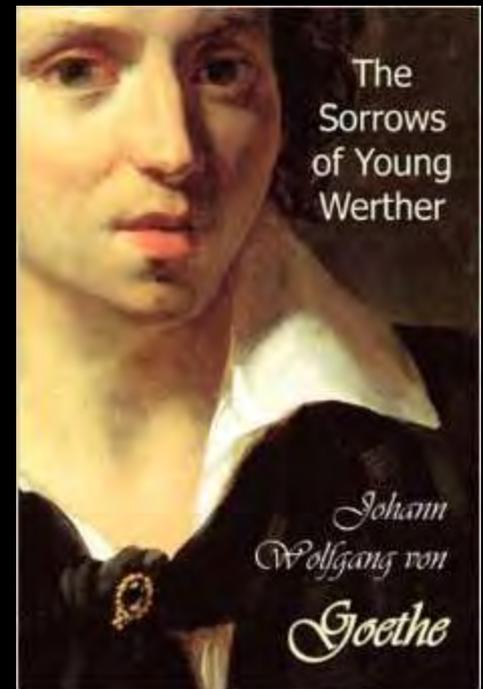
1794 Wilhelm moves to Jena – near Weimar and his friends Schiller and Goethe

Alexander visits and begins a life-long friendship with Goethe  
Later dedicates the *Essay on the Geography of Plants* to Goethe

Romanticism was an artistic, literary, and intellectual movement that originated in Europe toward the end of the 18th century and in most areas was at its peak in the approximate period from 1800 to 1850.

The movement emphasized intense emotion as an authentic source of aesthetic experience, placing new emphasis on such emotions as apprehension, horror and terror, and awe—especially that experienced in confronting the new aesthetic categories of the sublime and the beauty of nature.

An early German influence came from Goethe, whose 1774 novel *The Sorrows of Young Werther* had young men throughout Europe emulating its protagonist, a young artist with a very sensitive and passionate temperament.



## Johann Wolfgang von Goethe (1749—1832)

a German polymath—a painter, novelist, dramatist, poet, humanist, scientist, philosopher, and, for ten years, minister of state for the republic of Weimar.

1774: *Die Leiden des jungen Werthers* (The Sorrows of Young Werther)

1790: *Versuch die Metamorphose der Pflanzen zu erklären* (The Metamorphosis of Plants)

1808: *Faust Part One*

1810: *Zur Farbenlehre* (Theory of Colors)

1832: *Faust Part Two*

Romanticism assigned a high value to the achievements of "heroic" individualists and artists, whose examples, it maintained, would raise the quality of society.



## Seeking a foreign expedition 1797-99

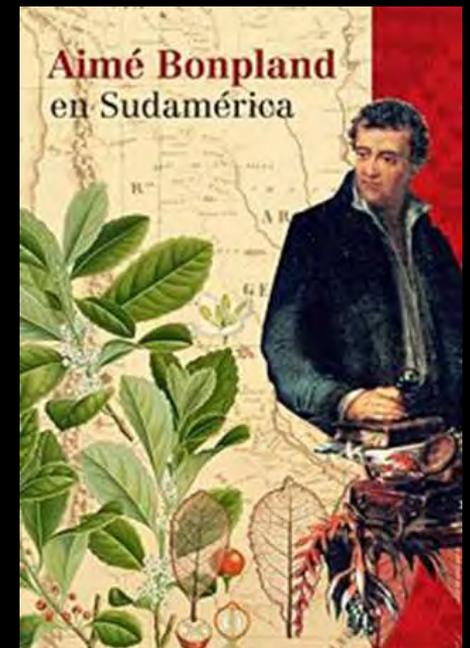
The death of his mother in 1796 sets him free.

1797 Scientific journey through the Alps taking magnetic, topographical, and meteorological measurements – practice for a bigger journey.

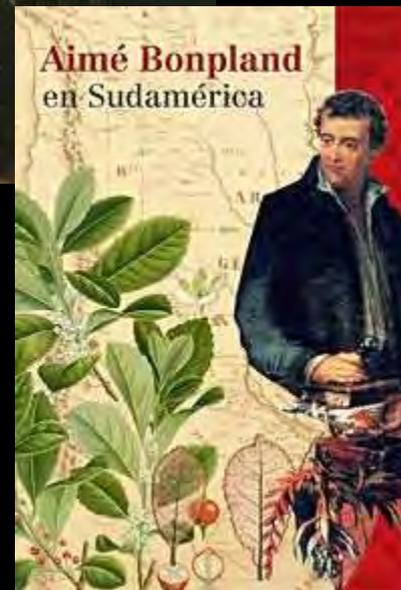
Publishes *Florae Fribergensis specimen plantas cryptogramicus praesertim subterraneas exhibens*, 1797. Humboldt's observations of underground plants made when he was a mining inspector.

Ends up in 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.

- Meets Louis-Antoine de Bougainville (1729-1811) first French circumnavigation of globe 1766-69, book *Voyage around the World* 1771
- Bougainville urged Humboldt to accompany him on a major expedition, likely to last five years,
- Meets Aimé Bonpland, the botanist and physician for the voyage.
- Bougainville voyage cancelled.
- Humboldt and Bonpland leave 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.



## Aimé Bonpland 1773 – 1858



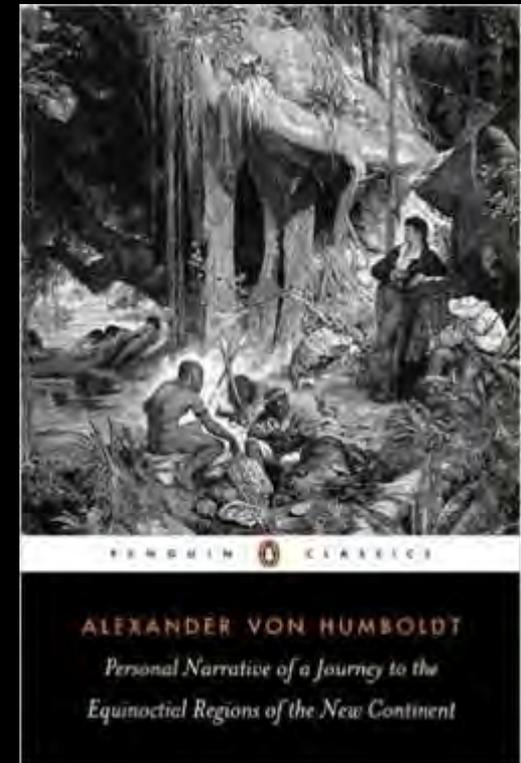
He collected and classified about 6 000 plants that were mostly unknown in Europe up to that time. Publishes *Essay on the Geography of Plants* with Humboldt.

1816 to Argentina and promotes harvesting and selling yerba mate through rest of his life

## 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 inclined to help Humboldt.

Humboldt's timing could not have been better to interest the Spanish crown in an extended scientific expedition to their possessions in the New World. Spain had guarded its realms against foreigner travelers and intruders. When Humboldt requested authorization from the crown to travel to Spanish America, most importantly, with his own financing, it was given positive response.

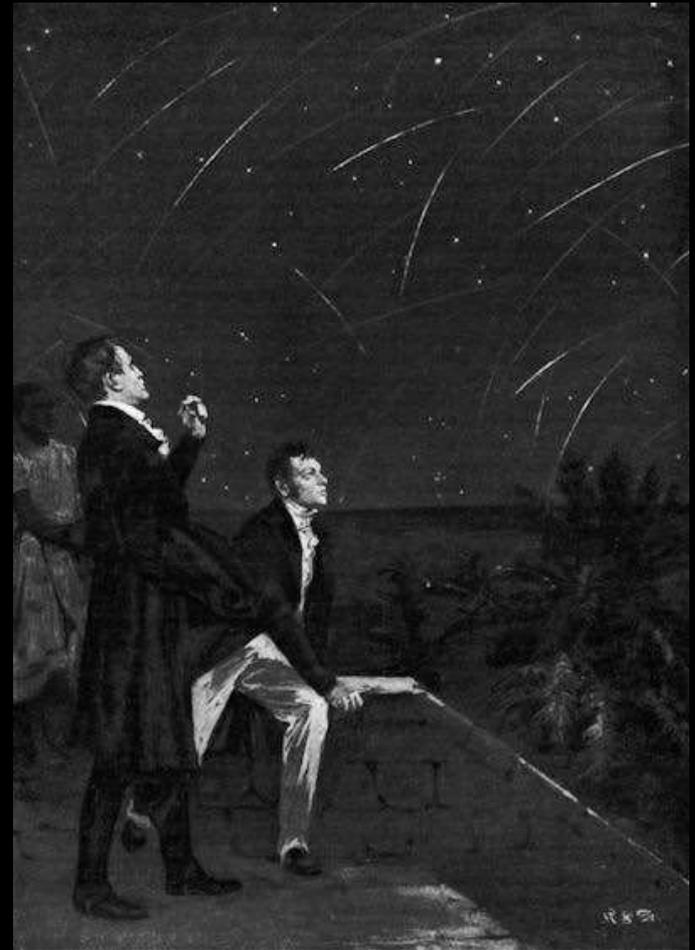




## Venezuela 1799–1800

Armed with authorization from the King of Spain, Humboldt and Bonpland made haste to sail, taking the ship Pizarro from Spain, 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 1799.

Humboldt observed, on the night of 11–12 November, a remarkable meteor shower. 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.



## Venezuela 1799–1800

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 had the important result of establishing the existence of the Casiquiare canal (a communication between the water-systems of the rivers Orinoco and Amazon).

Around March 1800, Humboldt and Bonpland observed 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.



AllPosters

## Cuba 1800 and on to the Andes 1801-3

On 24 November 1800, the two friends set sail for Cuba, landing on December 19 1800

Humboldt collected statistical information on Cuba's population, production, technology and trade

Humboldt and Bonpland stayed in Cuba until March 5, 1801, when they left for the mainland of northern South America again on March 30, 1801

arrived in Bogotá on July 6, 1801 where they met Spanish botanist José Celestino Mutis, Spanish priest, botanist and mathematician, staying there until September 8, 1801.

they reached Quito on 6 January 1802, after a tedious and difficult journey.



## Climbing Chimborazo

Five months after his arrival, Humboldt finally left Quito on 9 June 1802. He still intended to travel to Lima. From Lima Humboldt hoped to find passage to Mexico, which he also wanted to explore. First, though, he was going to climb Chimborazo—the crown of his obsession. This majestic inactive volcano—a ‘monstrous colossus’ as Humboldt described it—was about one hundred miles to the southwest of Quito and rose to almost 21,000 feet.



On 22 June they arrived at the foot of the volcano where they spent a fitful night in a small village. Early the next morning, Humboldt's team began the ascent together with a group of local porters. They crossed the grassy plains and slopes on mules until they reached an altitude of 13,500 feet. As the rocks became steeper, they left the animals behind and continued on foot

At 15,600 feet their porters refused to go on. Humboldt, Bonpland, Montúfar and José divided the instruments between them and continued on their own.

After an hour of treacherous climbing, the ridge became a little less steep but now sharp rocks tore their shoes and their feet began to bleed. Then, suddenly, the fog lifted, revealing Chimborazo's white peak glinting in the sun, a little over 1,000 feet above them—but they also saw that their narrow ridge had ended. Instead, they were confronted by the mouth of a huge crevasse which opened in front of them.

There was no way to cross. As they paused, Humboldt took out the barometer again and measured their altitude at 19,413 feet. Though they wouldn't make it to the summit, it still felt like being on the top of the world. No one had ever come this high—not even the early balloonists.

- From Wulf



## Naturgemälde - Nature was a living whole

When they returned from Chimborazo, Humboldt was ready to formulate his new vision of nature. In the Andean foothills, he began to sketch his so-called Naturgemälde, an untranslatable German term that can mean a 'painting of nature' but it also implies a sense of unity or wholeness.

It was, as Humboldt later explained, a 'microcosm on one page'. Unlike the scientists who had previously classified the natural world into tight taxonomic units along a strict hierarchy, filling endless tables with categories, Humboldt now produced a drawing.

'Nature was a living whole,' he later said, not a 'dead aggregate'. One single life, he said, had been poured over stones, plants, animals and mankind. It was this 'universal profusion with which life is everywhere distributed' that most impressed Humboldt. Even the atmosphere carried the kernels of future life—pollen, insect eggs and seeds. Life was everywhere and those 'organic powers are incessantly at work', he wrote. Humboldt was not so much interested in finding new isolated facts but in connecting them. Individual phenomena were only important 'in their relation to the whole', he explained. They were the parts that made the whole.



Depicting Chimborazo in cross-section, the Naturgemälde strikingly illustrated nature as a web in which everything was connected. On it, Humboldt showed plants distributed according to their altitudes, ranging from subterranean mushroom species to the lichens that grew just below the snow line. At the foot of the mountain was the tropical zone of palms and, further up, the oaks and fern-like shrubs that preferred a more temperate climate. Every plant was placed on the mountain precisely where Humboldt had found them.



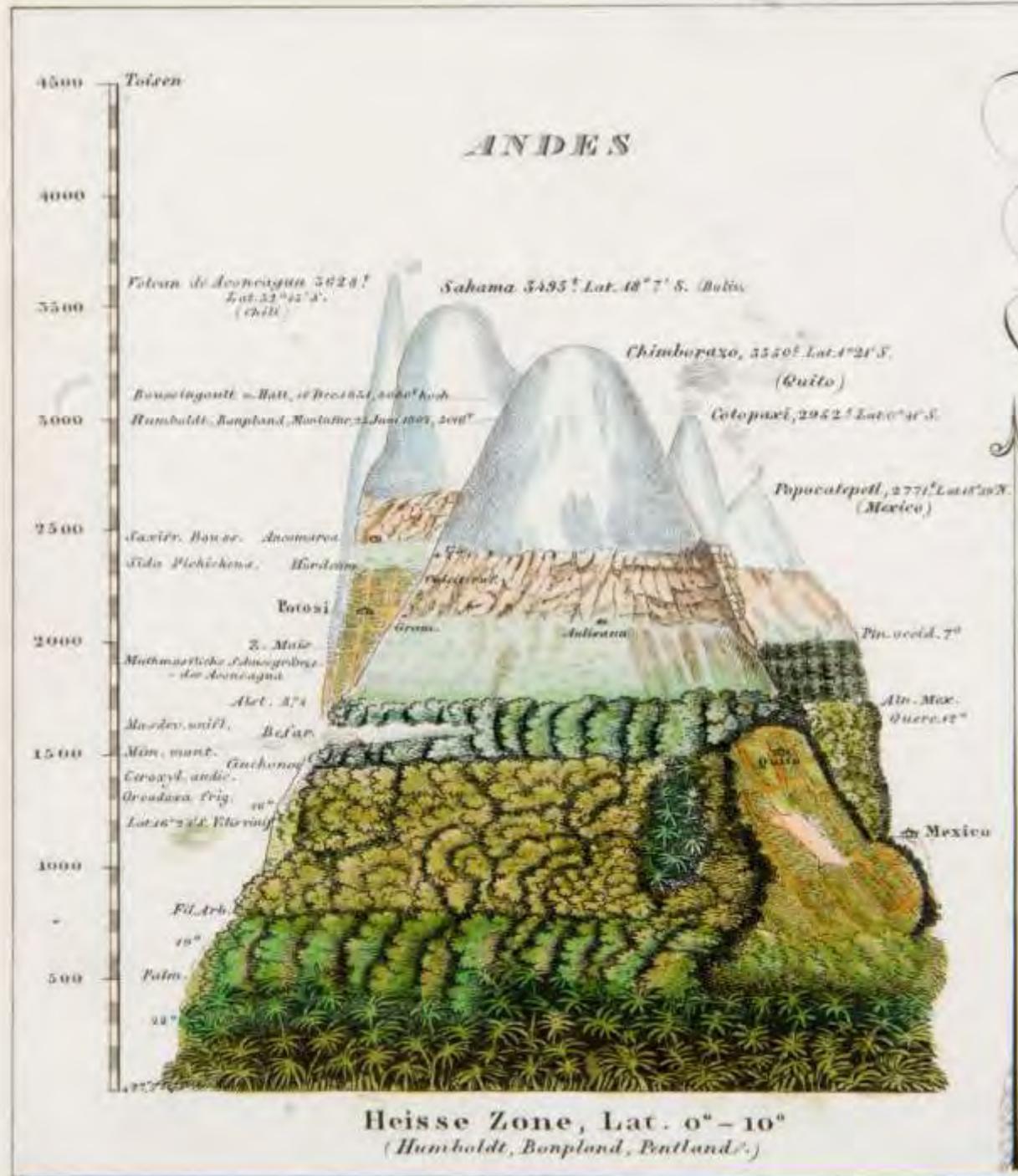
*Geographie der Pflanzen in den Tropen-Ländern ;  
 ein Naturgemälde der Anden,  
 gegründet auf Beobachtungen und Messungen, welche vom 10<sup>ten</sup> Grade nördlicher bis zum 10<sup>ten</sup> Grade südlicher Breite angestellt worden sind, in den Jahren 1799 bis 1805.  
 von ALEXANDER VON HUMBOLDT mit A. G. BONPLAND.*

This variety and richness, but also the simplicity of the scientific information depicted, was unprecedented.

Humboldt was the first scientist to present such data visually.

The Naturgemälde showed for the first time that nature was a global force with corresponding climate zones across continents. Humboldt saw 'unity in variety'.

Instead of placing plants in their taxonomic categories, he saw vegetation through the lens of climate and location: a radically new idea that still shapes our understanding of ecosystems today.



# A Vision of the Unity of Nature – Empirical Holism

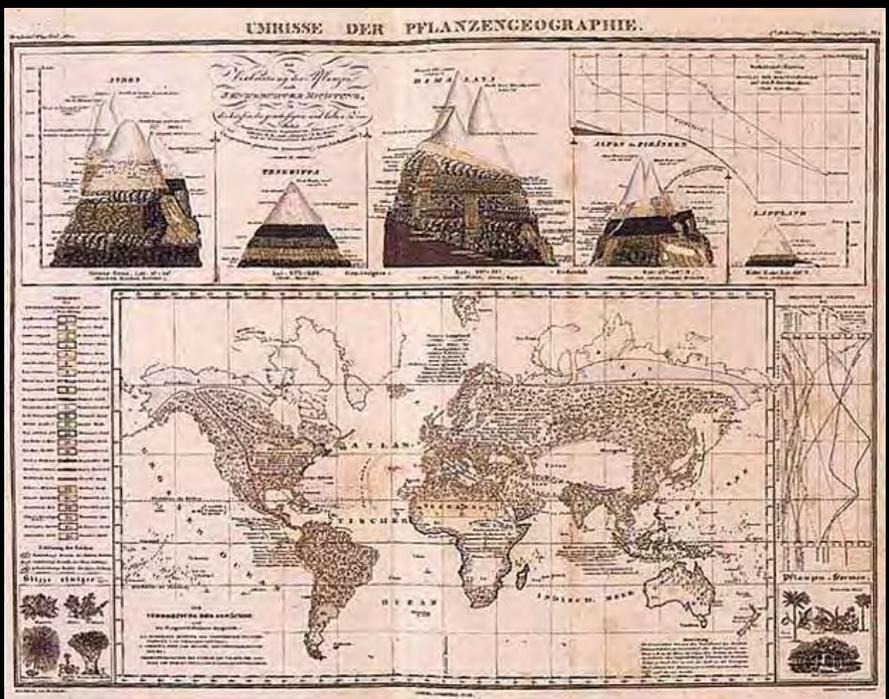
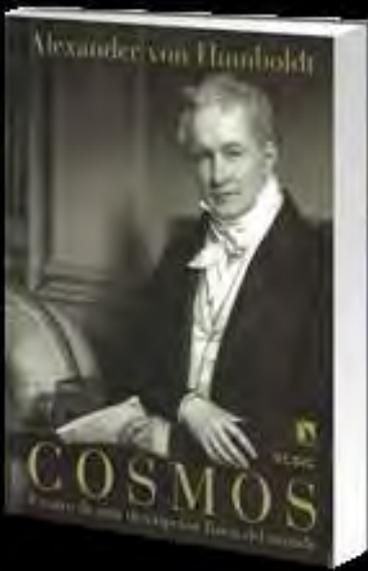
*Unity in diversity, and of connection, resemblance, and order, among created things most dissimilar in their form, one fair harmonious whole...*

*Kosmos, 1845*

The Rational Holist starts with a concept of the whole and thinks down to the necessary parts.

The Empirical Holist starts with the pieces and particulars as the present themselves to our ordering intelligence and works upward and outward seeking connections and drawing them into patterns.

As a sense of the whole emerges, it guides a deepening understanding of the interrelationship of the parts in a reciprocal spiral of ever deeper and wider knowledge.





PENGUIN  CLASSICS

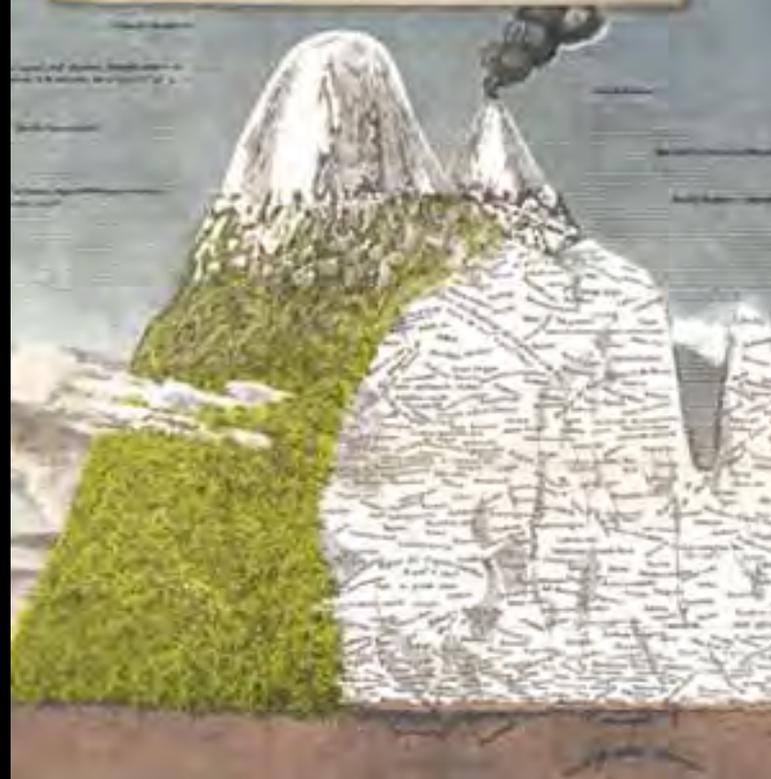
ALEXANDER VON HUMBOLDT

*Personal Narrative of a Journey to the  
Equinoctial Regions of the New Continent*

# Essay on the Geography of Plants

ALEXANDER VON HUMBOLDT  
AND AIMÉ BONPLAND

*Edited with an Introduction by Stephen T. Jackson*  
*Translated by Sylvie Romanowski*





Views of the Cordilleras and Monuments of  
the Indigenous Peoples of the Americas

*A Critical Edition*



ALEXANDER VON HUMBOLDT

*Edited by Vera M. Kutzvinski and Ottmar Elte*



# Views of Nature

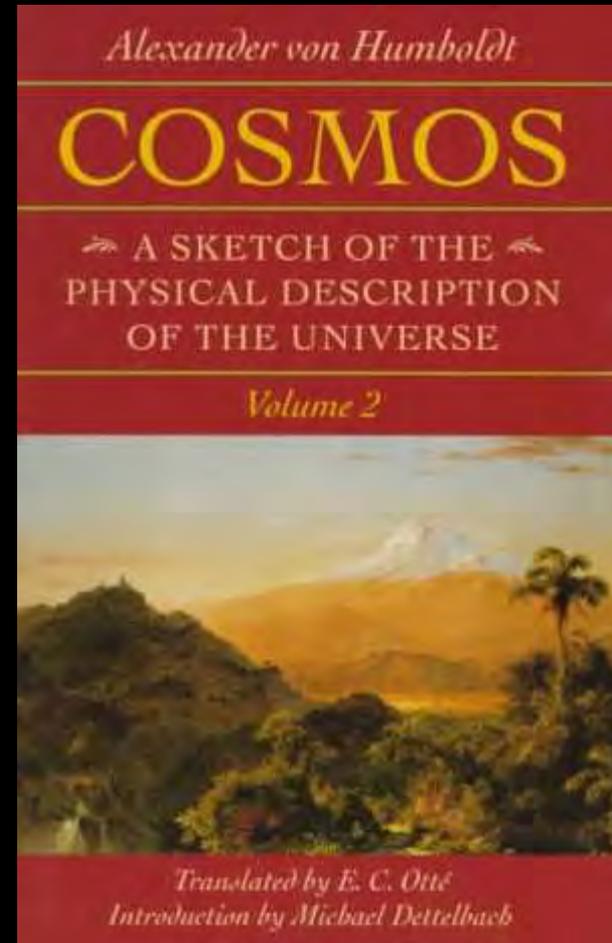
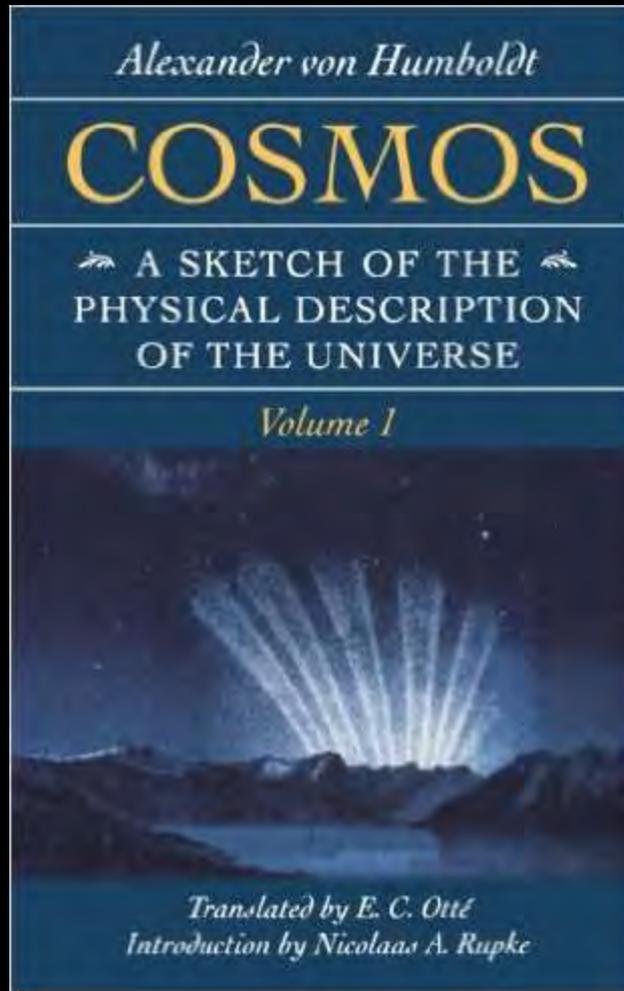
ALEXANDER VON HUMBOLDT

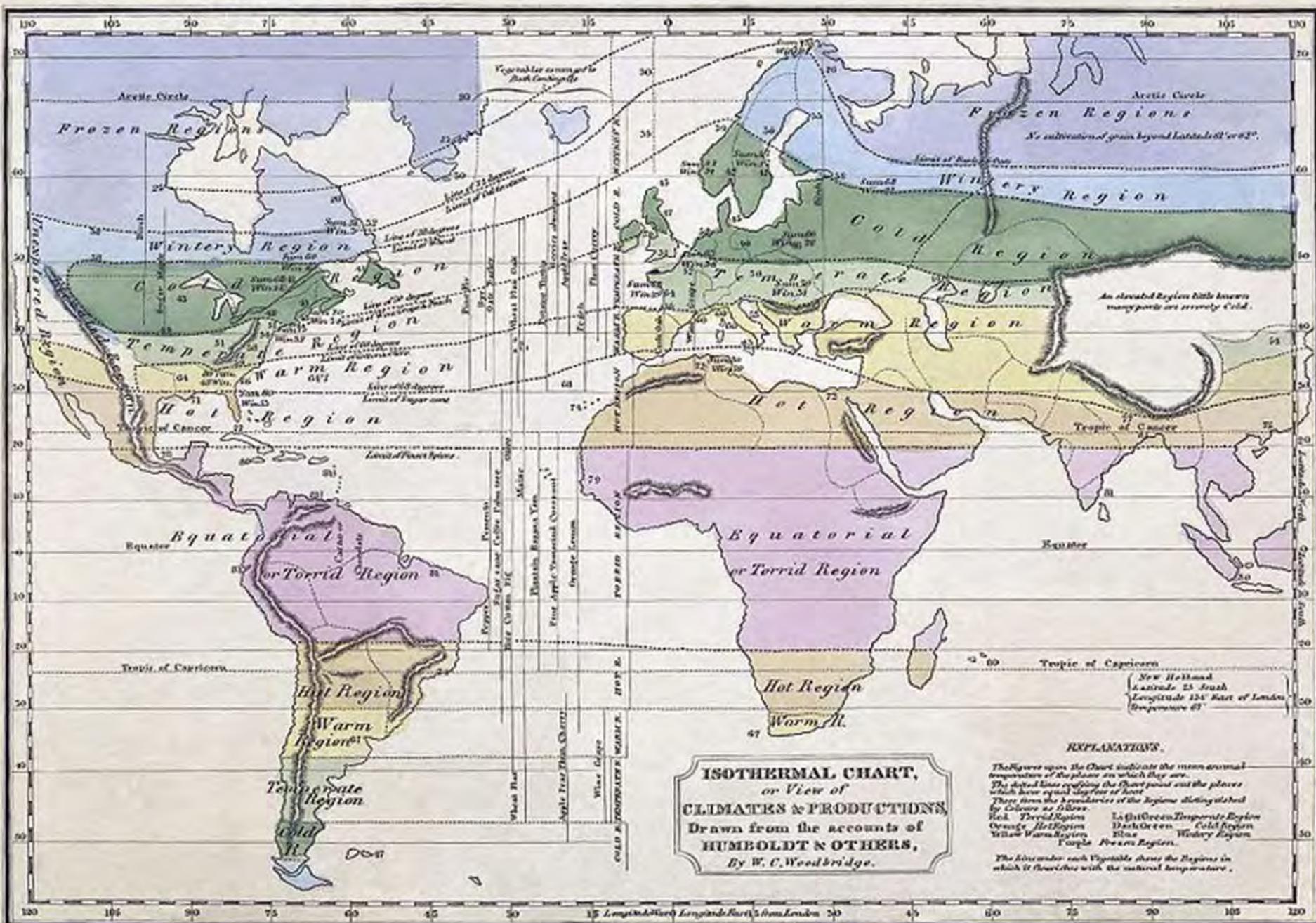
*Edited by Stephen T. Jackson and Laura Dassow Walls*

*Translated by Mark W. Peterson*



his five-volume opus *Cosmos* (1845-1862)





**ISOTHERMAL CHART,**  
*or View of*  
**CLIMATES & PRODUCTIONS,**  
 Drawn from the accounts of  
**HUMBOLDT & OTHERS,**  
*By W. C. Woodbridge.*

**EXPLANATIONS.**

The figures upon the Chart indicate the mean annual temperature of the places on which they are.  
 The dotted lines crossing the Chart point out the places which have equal degrees of heat.

These from the boundaries of the Regions distinguished by Colours are as follows.

Red	Torrid Region	Light Green	Temperate Region
Orange	Hot Region	Dark Green	Cold Region
Yellow	Warm Region	Blue	Wintery Region
Purple	Equatorial Region	White	Frozen Region

The lines under each Vegetable show the Regions in which it flourishes with the natural temperature.

Revised according to act of Congress the 15<sup>th</sup> day of January 1850. By William C. Woodbridge of the State of Massachusetts.