ALEXANDER VON HUMBOLDT *and the* United States

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with a preface by
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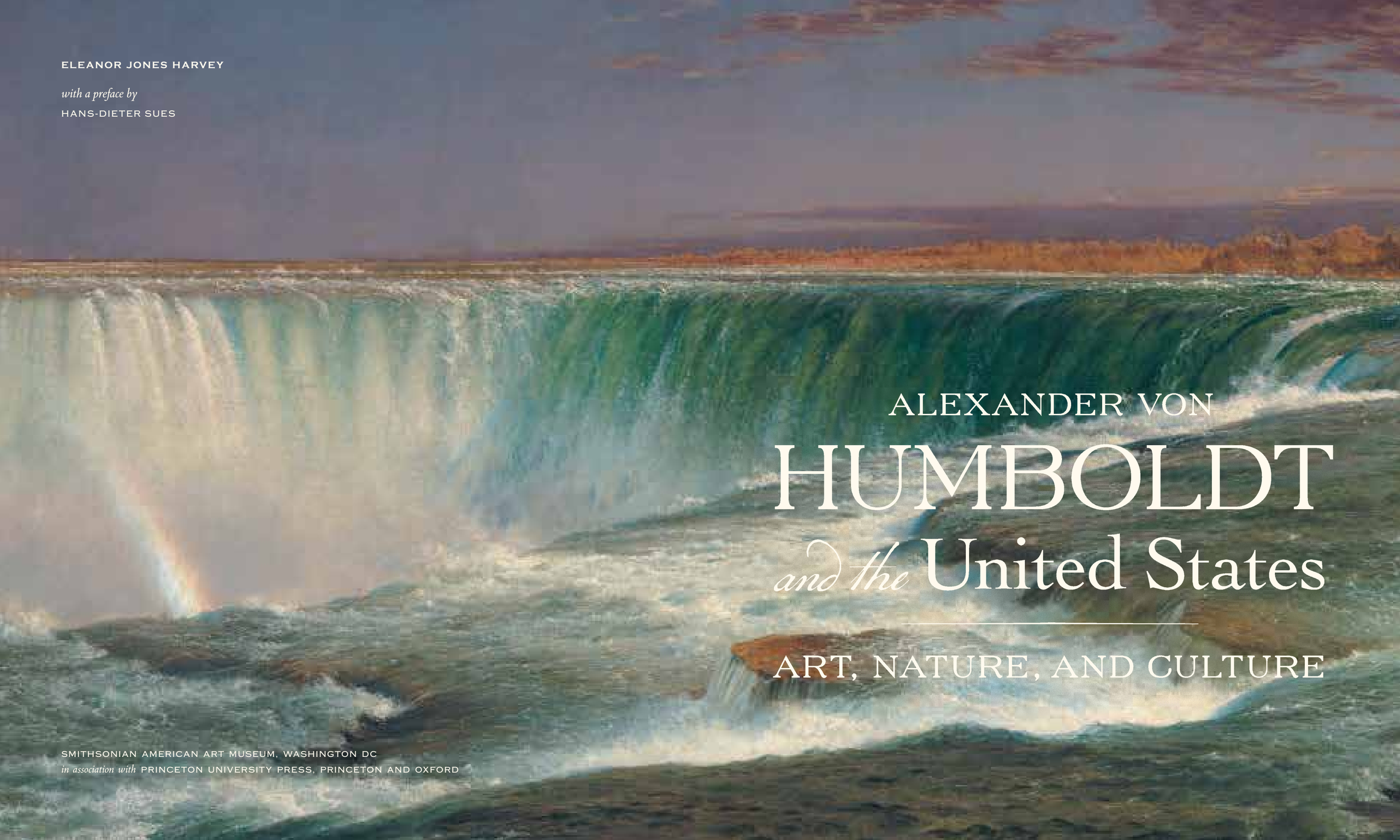

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ART, NATURE, AND CULTURE

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Alexander von Humboldt (1769–1859) was one of the most celebrated explorers of all time.[1] Ralph Waldo Emerson proclaimed him "one of those wonders of the world."[2] Humboldt was also a protean scholar whose seemingly boundless interests included astronomy, botany, chemistry, economics, geography, geology, physics, politics, and zoology. He and his elder brother, Wilhelm (1767–1835), a prominent philologist, educational reformer, and the driving force behind the establishment of the University of Berlin (which was renamed in the brothers' honor in 1949), became leading intellectual figures in the nineteenth-century German states.

Although Alexander von Humboldt came from a Prussian aristocratic family, he had enlightened views on political and social issues and was a lifelong outspoken opponent of slavery. At an early age, he became deeply interested in nature and avidly read books about exploration. After studies at the University of Frankfurt an der Oder, the University of Göttingen, and the Mining Academy of Freiberg, Humboldt worked for five years as a Prussian mining official. This provided him with the opportunity to conduct a wide range of scientific experiments and undertake applied research, such as the development of a respirator and a safety lamp for miners.[3]

Humboldt was eager to embark on a major journey to an unexplored region of the world. Early plans for trips to Egypt and to the West Indies never materialized due to war in Europe. Finally, authorized by King Carlos IV of Spain, he and the French naturalist Aimé Bonpland (1773–1858) set off in 1799 on a self-financed five-year voyage of exploration to the "equinoctial

regions" of the New World (Caribbean, northern South America, and Mexico), which established Humboldt's international reputation as an explorer.

Consistent with the precepts of the Enlightenment, Humboldt believed that the study of nature required observation and experimentation.[4] He advocated precise measurements of every physical parameter in a particular setting to elucidate the mutual interactions of physical forces. Humboldt argued that this should be done without any theoretical preconceptions. He obtained the best instruments available at the time for taking precise measurements. Humboldt believed that a wealth of such data would reveal nature as a dynamic equilibrium and the interconnectedness of physical forces. In the latter respect, he anticipated the Gaia hypothesis[5] proposed by James E. Lovelock and Lynn Margulis in the 1970s. At the same time, Humboldt also sought to connect this equilibrium with the aesthetic appreciation of cultured observers, which clearly linked him with the romantic tradition. To him, feeling and intellect represented complementary ways of understanding nature. Feeling provides the impetus for scientific exploration of natural phenomena and their connections. The knowledge gained from such studies, in turn, enhances appreciation of nature's beauty—allowing the observer to truly "see" the world.

HUMBOLDT'S IMPACT ON AMERICAN SCIENCE AND CULTURE

After his six-week visit to the United States in 1804, Humboldt stayed in contact with American politicians and scientists and maintained a keen interest in the political and intellectual development of the United States for the remainder of his life. On various occasions, he referred to himself as "half an American."[6] Humboldt's plan for a more extended stay in the United States was never realized. His *Personal Narrative of Travels to the Equinoctial Regions of the New Continent during the Years 1799–1804*[7] and especially his grand synthesis, *Cosmos*,[8] established him as a cultural icon in the United States during the first half of the nineteenth century. A fellow polymath and early American promoter of nature conservation, George Perkins Marsh (1801–1882) wrote admiringly that Humboldt's work

embraced the whole past history and present phase of every branch of physical research, and . . . was moreover graced with the elegances of all literature and dignified with the comprehensive wisdom of all philosophy.[9]

Humboldt's view of nature as a harmonious, interdependent whole influenced a wide range of American painters, thinkers, and writers, including Frederic Edwin Church, Ralph Waldo Emerson, Edgar Allan Poe, Henry David Thoreau, and Walt Whitman.[10]

Humboldt was excited by the prospects for exploration as the American frontier rapidly moved westward. In one of his farewell letters written at the end of his American sojourn, he noted, "This country that stretches to the west of the mountains presents a vast area to conquer for science."[11] This pronouncement and Humboldt's writings, especially *Personal Narrative*, influenced John C. Frémont (1813–1890) and others in the United States who later set out to explore and survey the American West prior to the Civil War.

Inspired and guided by Humboldt's work, Frémont scientifically documented physical settings he encountered in the American West and their faunas and floras.[12] He was also an excellent cartographer whose maps would aid countless Americans migrating to the West and led to him becoming popularly known as "the Pathfinder." Frémont honored Humboldt by bestowing his name on various geographic features in the American West. Humboldt effusively praised Frémont's work and arranged for the award of a gold medal to him from the king of Prussia.

Humboldt was an indefatigable correspondent who wrote and received tens of thousands of letters during his lifetime. He built and actively maintained a vast international and interdisciplinary network of contacts who exchanged information and opinions on a wide range of topics.[13] This enabled Humboldt to connect and support many scientists. In turn, it provided him with a rich supply of observations for his own work from correspondents worldwide.

Humboldt's approach to exploration also influenced early research on the ocean. Scientists started collecting data on the physical and chemical parameters of the sea at various depths and in different regions of the globe during the first half of the nineteenth century. During his journey from Lima, Peru, to Ecuador, Humboldt himself measured the temperature and direction of the now-eponymous cold-water current in the Pacific along the western coast of South America.

As the officer in charge of the United States Navy office (the precursor of today's United States Naval Observatory) in Washington, D.C., Matthew Fontaine Maury (1806–1873)[14] established the systematic gathering of information on sea conditions and weather by American shipmasters. Influenced by Humboldt, Maury used a vast trove of data to generate global characterizations of geographic systems, developing what Humboldt termed a "physical geography of the sea." In 1847 Maury published his widely acclaimed *Wind and Current Chart of the North Atlantic*. He was also interested in global wind patterns and their impact on ocean currents. Rejecting the then-prevailing notion that winds were responsible for the major oceanic currents, Maury maintained that these currents were the result of temperature-related changes in the density of seawater, which generate systems of circulation between the cool and warm regions of the globe. Finally, he prepared the first bathymetric map of the Atlantic Ocean. While not very accurate, this map was important for the laying of the first transatlantic cable, a project that Humboldt had enthusiastically supported.

HUMBOLDT AS MENTOR TO AMERICAN SCIENTISTS

Humboldt showed a remarkable talent for spotting and advancing the careers of promising young scientists. He had realized that he could not possibly survey the entire world by himself and hoped his protégés would conduct such studies across the globe. In particular, Humboldt mentored two men who went on to become leading figures in nineteenth-century American science—Louis Agassiz and Arnold Guyot.

Louis Agassiz (1807–1873) was a Swiss-born naturalist who made many important contributions to the life and earth sciences.[15] Early in his career, based in Neuchâtel, Agassiz was particularly interested in the diversity and interrelationships of extant and extinct fishes and echinoderms. Following up on earlier work by the German Swiss naturalist Jean de Charpentier and especially the German naturalist Karl Friedrich Schimper, he also investigated the movement and structure of glaciers in the Swiss Alps. The three researchers tried to relate various geological phenomena in the Alps, such as gravel beds and massive erratic blocks, to moving glaciers. Based on this work and observations elsewhere in Europe, Agassiz proposed the theory that glaciers had once covered much of Europe due to a dramatic drop in temperatures.[16]

Agassiz first met Humboldt when he moved to Paris to study with the eminent paleontologist and zoologist Georges Cuvier (1769–1832). Impressed by the energetic young naturalist, Humboldt became his patron and even subsidized the costly production of Agassiz's magisterial *Recherches sur les poissons fossiles* (1833–44). With Humboldt's encouragement and with financial support from the king of Prussia (on Humboldt's recommendation), Agassiz traveled to the United States in 1846 to explore the animal and plant life of this country for two years. A course of public lectures at the Lowell Institute in Boston quickly generated new contacts and opportunities for Agassiz, and he soon decided to remain in America permanently. He married into one of Boston's leading families. His wife, Elizabeth Cabot Cary, later cofounded Radcliffe College. As a professor at Harvard's Lawrence Scientific School, Agassiz founded the Museum of Comparative Zoology and developed it into a leading center for the study of comparative anatomy and animal diversity.[17] An engaging lecturer, his teaching emphasized fieldwork and direct observation of specimens over traditional memorization of published facts. Although Agassiz organized various expeditions, including a voyage to Brazil in 1865 to find evidence contradicting Darwin's theory, he no longer produced groundbreaking scholarship later in his life. He did much, however, to advance the cause of natural history in the United States because he firmly believed that the study of nature could influence and inspire American politics. Agassiz was a major force behind the establishment of the National Academy of Sciences in 1863. In his capacity as a regent of the Smithsonian Institution, he helped guide the early development of the nation's foremost museum and research complex.

Although Agassiz always presented himself as a disciple and close friend of Humboldt, he was

an outspoken proponent of "scientific" racism, which was anathema to his mentor and cast a deep shadow over his scholarly legacy. He also wanted to use science to advance a national agenda, unlike Humboldt's cosmopolitan concept of science.

During a visit to Philadelphia in 1846, Agassiz developed a visceral dislike of blacks, which, coupled with his obsession about the consequences of miscegenation, led him to argue that the different races of humans represented separate species. He was influenced by the polygenism of the physician Samuel George Morton (1799–1851) in Philadelphia. Morton had measured a large number of human skulls to determine their brain volume (without accounting for body size and sex) and, based on a highly biased analysis, asserted that whites had greater brain capacity than blacks and Native Americans.[18] Agassiz first expounded his view in the *Christian Examiner* in 1850. Because his claims had already been criticized for contradicting the biblical narrative of human creation, he argued that all humans shared a "unity of type" and that the scripture only referred to the origin of the white race from Adam and Eve. Agassiz believed that the human races had originated in the discrete geographic regions that they occupy in the present day (although migration had subsequently obscured some of the boundaries between these regions). In his view, the races all met the biological criteria to be considered separate species. Agassiz continued, "It seems to us to be mock-philanthropy and mock-philosophy to assume that all races have the same abilities, enjoy the same powers, and show the same natural dispositions, and that in consequence of this equality they are entitled to the same position in human society."[19]

Another proponent of "scientific" racism, Reverend John Bachman (1790–1874), a naturalist and minister in Charleston, South Carolina, took issue with Agassiz's polygenism. In Bachman's view, it not only contradicted the biblical account of human creation but was biologically unsound in its interpretation of human races as distinct species. He argued for the unity of the human species, citing Humboldt, although he did not accept this as an argument in support of racial equality.[20]

However, Agassiz kept Humboldt's intellectual legacy alive well after his mentor's passing. His 1850 book on Lake Superior and his ambitious but unfinished monograph series *Contributions to the Natural History of the United States of America* clearly reflected his mentor's comprehensive, empirical approach to the study of nature.[21]

Humboldt also mentored another Swiss-born naturalist, Arnold Guyot (1807–1884).[22] Guyot first met Agassiz as a young student in Karlsruhe, and the two men became lifelong friends. He became acquainted with Humboldt while studying in Berlin. Early in his career, Guyot examined glaciers in Switzerland and provided important information in support of Agassiz's glacial hypothesis. He later joined his friend on the faculty of the College of Neuchâtel, which had been established by the Prussian king in 1838. At Agassiz's urging, Guyot immigrated to the United States after the college's operations ceased following the revolutions of 1848. Like Agassiz, he delivered a course of invited lectures at the Lowell Institute in Boston. In 1854 Guyot received a faculty appointment at the College of New Jersey (later renamed Princeton University), where he taught for the remainder of his life. His research was concerned with geography, which was clearly influenced by Humboldt's thinking on this subject, and he was also interested in meteorology. His efforts to develop a national system for meteorological observations led to the establishment of the United States Weather Bureau (the precursor of today's National Weather Service) in 1870.

Like Agassiz, Guyot differed from Humboldt in his thinking about race. In his book *The Earth and Man* (first published in 1849), he twisted Humboldt's ideas concerning the relationships between plants and climate to argue that permanent racial differences were determined by geography. In Guyot's view, "[t]he people of the temperate continents will always be the men of intelligence, of activity, the brain of humanity, if I may venture to say so; the people of the tropical continents will always be the hands, the workmen, the sons of toil."[23]

HUMBOLDT'S CONTRIBUTIONS TO THE SCIENCES

Many hagiographic accounts have celebrated Alexander von Humboldt as a universal genius who laid the foundations for many sciences. However, as even his earliest scientific biographers pointed out, Humboldt never made a single groundbreaking scientific discovery nor did he formulate a major theory that posterity would come to firmly associate with his name. Working as a private scholar, he was not the founder of an academic school, but he served as mentor to many a young scientist. The sheer breadth of his interests led Humboldt to eschew in-depth pursuit of any particular line of scientific research. Instead he encouraged others to undertake the detailed examination of specific topics. A well-known example is Humboldt's discovery that the intensity of Earth's magnetic field decreases from the poles to the equator. He left it to his friend, the mathematician Carl Friedrich Gauss (1777–1855), to develop a method for determining the strength of Earth's magnetic field.[24] Thus, even his early scientific biographers considered Humboldt a heroic explorer, a tireless collector of data, and a gifted public communicator of science rather than an original creative mind.[25] Indeed, Humboldt is most widely known for his holistic thinking about nature and for introducing nature and world cultures to diverse audiences. However, he also could look back on numerous scientific accomplishments. The impact of much of Humboldt's research has yet to be critically reassessed by modern historians of science.

Humboldt and Bonpland's *Essai sur la géographie des plantes* (1805) is generally considered the foundation of plant biogeography.[26] Humboldt acknowledged earlier efforts, especially by his friends Georg Forster (1754–1794) and Karl Ludwig Willdenow (1765–1812), to document and interpret the geographic distribution of plants. Humboldt's work explored the spatial relationships of plants to one another and to geographically variable physical parameters such as altitude, humidity, and temperature. He contrasted his undertaking with traditional botanical research, which primarily focused on classifying plants based on their structural attributes and which he considered a critical first step in interpreting patterns of plant distribution. Humboldt's studies on the interactions of plants with one another and their relationships to their physical environment also established him as a pioneer in ecology,[27] although his contributions to this biological discipline (which was not formally designated until 1866) are often not fully recognized.

Together with Carl Ritter (1779–1859), Humboldt is regarded as the founder of modern geography.[28] Humboldt conducted regional studies with special consideration of conditions relevant to human geography as well as economic and political systems. Through this research, his innovative representations of geographic data (e.g., his famous illustration of the Andean volcano Chimborazo showing vegetation zones at different altitudes), and his exacting work as a cartographer, he contributed substantially to the development of geography as a science.

Carl Ritter became interested in the relationships between humanity and nature early in his career.[29] This interest deepened when he met with Humboldt in 1807. Later both scholars were active in Berlin. Ritter took a comparative approach to geography, aimed at establishing the interdependence of all phenomena on Earth's surface. He tried to demonstrate the individuality of continents, believing that their distinctive shapes and locations were based on a divine plan to facilitate the development of human civilization.[30] Like Humboldt, Ritter wanted to accumulate, without preconceived notions, as many observations as possible on particular regions of the globe in order to discover laws underlying the relationships between humans and the natural world. Unlike Humboldt, however, he was unabashedly Eurocentric in his views, regarding Europe as home to humanity's greatest achievements.[31] Ritter's methods for and writings about geographic research, especially social geography, influenced the historical development of this academic discipline.[32]

Humboldt made many empirical contributions across a wide range of sciences, including physics and geology. The extensive, well-documented collections of plants, many of them new to science, made by Bonpland and Humboldt in the Caribbean and South America laid the foundation for our understanding of neotropical plant diversity.[33]

Consistent with his egalitarian outlook, Humboldt tried to make his observations and thinking widely accessible.[34] His public lectures in Berlin in 1827 and 1828 attracted many women, who at that time were still not admitted to universities yet constituted a major community of readers, as well as people from a wide range of social backgrounds. The popular appeal of Humboldt's presentations and the great success of his books in Europe and the United States testified to the efficacy of his communication efforts.

Following Humboldt's passing on May 6, 1859, his influence in the United States rapidly waned. Cities across America still celebrated the centennial of his birth on September 14, 1869, with dedications of memorials and many speeches paying homage to his life and accomplishments.[35] However, a major 1890 review of the beginnings of American science[36] did not even mention Humboldt. By the end of the nineteenth century, only academic geographers still held Humboldt in high regard.[37] During much of the twentieth century, few Americans had ever heard of Humboldt. In recent years, however, there has been a major resurgence of interest in his life and work in the United States. Books by Aaron Sachs, Laura Dassow Walls, and Andrea Wulf[38] have reintroduced Humboldt and his influence on American cultural development to a wider readership.

Various reasons have been suggested for Humboldt's precipitous descent into obscurity in the United States during the second half of the nineteenth century.[39] His reputation remained undiminished in Germany although his work and thoughts were successively reinterpreted in light of the prevailing political ideologies during the turbulent modern history of that country.[40] Humboldt continued to be regarded as a major historical figure in Latin America, in part due to his friendship with Simón Bolívar, the liberator of the Spanish colonies in northern South America.[41] The two men had first met in Paris in 1804. Bolívar noted that "[Humboldt's] learning has done America more good than all of the conquistadores," and he considered Humboldt "the discoverer of the New World."[42]

An important factor behind Humboldt's descent into oblivion in the United States was increasing public hostility against the influx of immigrants from Germany, culminating in the anti-German hysteria during World War I. These campaigns helped erase Humboldt and other German cultural figures from the public memory for many years.

Starting in the mid-nineteenth century, Humboldt's ideas and methods increasingly were at odds with emerging scientific practice in the United States and Europe. The rapid expansion of knowledge and the professionalization of science led to profound changes. Individual scientific disciplines became the domains of full-time, academically trained specialists who focused on empirical studies of specific natural phenomena and processes and eschewed grand syntheses in the Humboldtian mode. Amateur naturalists continued to contribute to some disciplines (e.g., botany) by gathering data in the field, but other disciplines (e.g., physics) became closed to them. The life sciences witnessed a major shift in emphasis, in part due to their growing academic affiliation with medicine.[43] Laboratory-based experimental research in subjects such as cytology, embryology, and physiology soon eclipsed fieldwork exploring organic diversity in its natural settings. Concurrently, scientists adopted a technical style of writing that was aimed at fellow researchers rather than the reading public.

Through his writings, however, Humboldt continued to inspire many younger scientists to explore the interactions in the natural world. Charles Darwin (1809–1882) took Humboldt's *Personal Narrative* along on his voyage on the HMS *Beagle*.[44] He was strongly influenced by this book and modeled his own *Journal of Researches* on it. Darwin considered Humboldt an inspiration, who "like another Sun illumines everything I behold."[45] In 1881, one year before his death, Darwin wrote to his friend Joseph Dalton Hooker:

I believe that you are fully right in calling Humboldt the greatest scientific traveller who ever lived. You might truly call him the parent of a grand progeny of scientific travellers, who taken together have done much for science.[46]

He had once met Humboldt in person but "remember[ed] nothing distinctly about [their] interview, except that Humboldt was very cheerful and talked much."[47] Like the elder scholar, Darwin perceived and appreciated nature aesthetically and intellectually. Both felt they were part of nature through their experiences and keenly appreciated the sublime beauty of natural phenomena. A recent study has documented how Darwin, during the earlier phases of his career, was profoundly influenced by not only Humboldt but also poets like John Milton and William Wordsworth.[48] Darwin's prose in his earlier works, such as his *Journal of Researches* and his magnum opus, *On the Origin of Species*, reflects that influence. Later, as a pillar of the scientific establishment, Darwin became more cautious in his expressions and adopted much less florid language.[49]

Humboldt and Darwin shared a holistic view of nature. However, deeply influenced by Charles Lyell's *Principles of Geology* (1830–33), Darwin went further than Humboldt in relating the development of the living world to geological processes and changes. He posited that all species evolved from a limited number of common ancestors and transformed over time—descent with modification.[50] According to Darwin, natural selection was the external force behind the changes that conferred advantages on organisms and species in their struggle for existence.

Darwin's theory of evolution by natural selection presented a view of life that stood in stark contrast to Humboldt's worldview.[51] Darwin's ever-changing world is one of unceasing struggle for survival, with individual organisms locked in competition with each other. By contrast, Humboldt's vision of nature emphasizes balance and harmony, with an integrated whole emerging from the complex interactions of countless animate and inanimate elements. In Darwin's world, evolutionary change does not foster harmony in nature, nor is it driven by some internal force. His vision won out, in part because it aligned well with the prevailing political and economic views in Europe and the United States during the late nineteenth and early twentieth centuries. There is no unambiguous record in Humboldt's writings that he ever entertained notions of evolutionary transformation. Indeed, he explicitly rejected efforts by other researchers to link present-day species to extinct ones.[52]

HUMBOLDT'S RENAISSANCE

In his writings, Humboldt repeatedly stressed the threat humans posed to nature. He first recognized the connection between deforestation and regional climate change and witnessed the adverse environmental impact of agricultural practices while traveling through Venezuela in 1800.[53] Humboldt saw humans as part of nature, not outside it, and warned that they were capable of destroying it. He viewed the atmosphere, land and sea, and all life—including humans—as parts of a harmonious, interconnected, and interdependent whole. Thus, Humboldt has been considered a proto-environmentalist.[54] Unfortunately, increasing scientific specialization during the nineteenth and first half of the twentieth century left no room for the development of an integrative research program based on a Humboldtian vision. Humboldt's thinking was also in conflict with the traditional view (informed by religious teaching) that nature had been created solely for humanity's benefit, enjoyment, and exploitation. However, his vision found enthusiastic reception by nineteenth-century American naturalists, including George Perkins Marsh and the "patron saint" of American environmentalism, John Muir (1838–1914). In his book *Man and Nature, or, Physical Geography as Modified by Human Action* (first published in 1864), Marsh discussed environmental degradation due to human agency in geographic and historical terms. He urged people to restore past damage inflicted on and prevent further destruction of nature.[55] Marsh had earlier stated, "[W]hereas Ritter and Guyot think that the earth made man, man in fact made the earth."[56]

Humboldt's vision of nature has become relevant again now that humanity faces a global environmental crisis. Most present-day scientists lack Humboldt's holistic perspective of nature. Instead they tend to focus on specific ecological changes without considering the complex web of interactions between humans and the environment. Furthermore, the current environmental movement often focuses on the preservation of animals, plants, or places rather than taking a more integrated approach that also considers humans.[57] Not enough is done to stimulate the public's appreciation of the natural world and to help people comprehend its vital importance for humanity. There is an urgent need for a Humboldtian perspective if we are to understand and address the unparalleled crisis now facing our species.

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NOTES

1 The most comprehensive treatment of Alexander von Humboldt's life and work is Hanno Beck's two-volume monograph: *Alexander von Humboldt, Band 1: Von der Bildungsreise zur Forschungsreise 1769–1804*; and *Alexander von Humboldt, Band 2: Vom Reisewerk zum "Kosmos" 1804–1859* (Wiesbaden, Germany: Franz Steiner Verlag, 1959).

2 "An abstract of Emerson's remarks made at the celebration of the centennial anniversary of the birth of Alexander von Humboldt, September 14, 1869," in Ralph Waldo Emerson, *The Complete Works,* vol. 11, *Miscellanea* (New York and Boston: Houghton Mifflin, 1904), 457. See https://www.bartleby.com/90/1124.html.

3 Ursula Klein, "The Prussian Mining Official Alexander von Humboldt," *Annals of Science* 69, no. 1 (2012): 27–68.

4 The classic study on "Humboldtian science" is Susan F. Cannon, *Science in Culture: The Early Victorian Period* (New York: Science History Publications, 1978), 73–110.

5 James E. Lovelock and Lynn Margulis, "Atmospheric Homeostasis by and for the Biosphere: The Gaia Hypothesis," *Tellus* 26, nos. 1–2 (1974): 2–10. See also James E. Lovelock, *The Ages of Gaia: A Biography of Our Living Earth* (New York: W. W. Norton, 1995).

6 "Sitzung vom 7. Mai 1859," *Zeitschrift für allgemeine Erdkunde,* Neue Folge 6 (1859): 414–16. A statement by the ambassador of the United States to Prussia, Joseph A. Wright, is cited on p. 415.

7 Alexander von Humboldt and Aimé Bonpland, *Personal Narrative of Travels to the Equinoctial Regions of the New Continent, during the Years 1799–1804*, 7 vols., trans. Helen Maria Williams (London, England: Longman, Rees, Orme, Brown, and Green, 1814–29).

8 Alexander von Humboldt, *Cosmos: A Sketch of the Physical Description of the Universe*, 5 vols., trans. E. C. Otté (London, England: Henry G. Bohn, 1849–70).

9 George Perkins Marsh, "The Study of Nature," *Christian Examiner* 68 (January 1860): 33–62. Quotation appears on p. 44.

10 Stephen Jay Gould, "Church, Humboldt, and Darwin: The Tension and Harmony of Art and Science," in *The Paintings of Frederic Edwin Church*, ed. Franklin Kelly (Washington, DC: National Gallery of Art, 1989), 94–107. See also Frank Baron, "From Alexander von Humboldt to Frederic Edwin Church: Voyages of Scientific Exploration and Artistic Creativity," *Internationale Zeitschrift für Humboldt-Studien* 6, no. 10 (2005): 2–15.

11 Humboldt to William Thornton, 20 June 1804. See Ulrike Moheit, ed., *Alexander von Humboldt: Briefe aus Amerika, 1799–1804* (Berlin, Germany: Akademie Verlag, 1995), 299–300.

12 For biographies of Frémont, see Ferol Egan, *Frémont: Explorer for a Restless Nation* (Garden City, NY: Doubleday, 1977); and Tom Chaffin, *Pathfinder: John Charles Frémont and the Course of American Empire* (New York: Hill and Wang, 2002).

13 Ottmar Ette, "Alexander von Humboldt, die Humboldtsche Wissenschaft und ihre Relevanz im Netzzeitalter," *Internationale Zeitschrift für Humboldt-Studien* 7, no. 12 (2006): 32–39.

14 For a recent review of Maury's contributions, see Jason W. Smith, *To Master the Boundless Sea: The U.S. Navy, the Marine Environment, and the Cartography of Empire* (Chapel Hill: University of North Carolina Press, 2018).

15 Edward Lurie, *Louis Agassiz: A Life in Science* (Chicago: University of Chicago Press, 1960).

16 See Louis Agassiz, *Études sur les glaciers* (Neuchâtel, Switzerland: Jean et Gassmann, 1840); and Louis Agassiz, *Théorie des glaces et ses progres les plus récents* (Genève, Switzerland: Bibliothèque Universelle de Genève, 1842).

17 For a history of the Museum of Comparative Zoology, see Mary P. Winsor, *Reading the Shape of Nature: Comparative Zoology at the Agassiz Museum* (Chicago: University of Chicago Press, 1991).

18 Stephen Jay Gould, *The Mismeasure of Man* (New York: W. W. Norton, 1981). Concerning Samuel George Morton, see pp. 50–69.

19 Louis Agassiz, "The Diversity of Origin of the Human Races," *Christian Examiner* 49 (July 1850): 110–45. Quotation appears on p. 143.

20 John Bachman, *The Doctrine of the Unity of the Human Race Examined on the Principles of Science* (Charleston, SC: C. Canning, 1850).

21 Louis Agassiz, *Lake Superior: Its Physical Character, Vegetation, and Animals, Compared with Those of Other and Similar Regions* (Boston: Gould, Kendall and Lincoln, 1850); and Louis Agassiz, *Contributions to the Natural History of the United States of America* (Boston: Little, Brown, 1857). Only four of a projected ten volumes were ever published.

22 James D. Dana, "Memoir of Arnold Guyot, 1807–1884," *Biographical Memoirs of the National Academy of Sciences* 2 (1886): 309–47.

23 Arnold Guyot, *The Earth and Man: Lectures on Comparative Physical Geography, in Its Relation to the History of Mankind*, trans. C. C. Felton (Boston: Gould and Lincoln, 1855). Quotation appears on p. 331.

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