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Beiträge

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Humboldt's science on the move – plant geographical observations, notes and encounters during his American voyage

ZUSAMMENFASSUNG

Alexander von Humboldt beschäftigte sich seit den frühen 1790er Jahren mit der Pflanzengeographie. In seinen „Ideen zu einer Geographie der Pflanzen" (1807) stellte er ein Forschungsfeld vor, das Mensch und Natur, Ästhetik und quantitative Wissenschaften umfasst. Die vorliegende Arbeit schlägt einen neuen Zugang zu diesem komplexen Forschungsprogramm vor. Eine genaue Lektüre der pflanzengeographischen Aufzeichnungen, die er während seiner Amerikareise anfertigte, gibt Einblick in den situativen und zuweilen zufälligen Charakter von Humboldts Wissenschaft. Humboldt glich seine Erfahrungen in den Tropen mit vorgefassten europäischen Vorstellungen von Naturgeschichte ab. Die Reiseroute selbst und die persönlichen Begegnungen spielten eine wichtige Rolle bei der Ausgestaltung von Humboldts pflanzengeographischen Überlegungen.

ABSTRACT

Alexander von Humboldt studied plant geography from the early 1790s onwards. In the "Essay on the Geography of Plants" (1807) he presents a field of science that encompasses man and nature, aesthetics and quantitative sciences. This paper suggests a novel approach to this complex research program. A close reading of the notes on plant geography taken during his American voyage gives insight into the situational and at times contingent nature of Humboldt's science. Humboldt aligned his experience of the Tropics with preconceived European notions of natural history. The travel route itself and personal encounters played a significant part in re-shaping Humboldt's plant-geographical ideas.

RÉSUMÉ

Alexander von Humboldt étudia la géographie des plantes dès le début des années 1790. Dans son « Essai sur la géographie des plantes » (1807), il présente un domaine scientifique qui englobe l'homme et la nature, l'esthétique et les sciences quantitatives. Cet article propose une nouvelle approche de ce programme de recherche complexe. Une lecture approfondie des notes sur la géographie des plantes prises au cours de son voyage en Amérique donne un aperçu de la nature situationnelle et parfois casuelle de la science de Humboldt. Humboldt a aligné son expérience des Tropiques sur les notions européennes d'histoire naturelle préconçues. L'itinéraire du voyage lui-même et les rencontres personnelles ont joué un rôle important dans le remodelage des idées phytogéographiques de Humboldt.

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Introduction[1]

For several decades, Alexander von Humboldt's scientific endeavors have been subject to historical reinterpretation. This involves, on the one hand, reassessing the broad lines of his heuristic concept and, on the other, interrogating Humboldt's practices in the field and at his desk. Scholars have successfully historicized and deconstructed the long-influential concept of "Humboldtian Science," which describes the practice of serial and globally coordinated measurement of numerous, interrelated geophysical phenomena using precise instruments (Cannon 1978; Dettelbach 1996). While Humboldt advocated for this research approach and even selectively implemented it, his scientific biography, spanning over seven decades, cannot fully be captured by this concept (Daum 2024). This means that Humboldt's science must be contextualized within the respective biographical context.[2] This task is inherently complex for a number of reasons, primarily due to the fact that the naturalist's lengthy lifetime and remarkable productivity make it challenging to fully comprehend all the nuances involved in his scientific endeavors. The epochal political, cultural, and scientific changes around 1800, which were reflected in Humboldt's evolving worldview, are impressively yet inadequately described by the early biographical stations of Berlin, Göttingen, Weimar/Jena, and Paris. Additionally, the traveler's hemispheric journeys brought Madrid, Quito, Havana, Philadelphia, and St. Petersburg into his mental horizon, expanding the scope of his intellectual engagement to a global scale.

A second avenue of inquiry within the field of Humboldt research aligns with the general trend in the historiography of science towards practices of observation and writing. The complete digitization of Humboldt's papers in Berlin and Krakow, including the American travel journals, provided a major impetus. The thousands of manuscript pages available online in open access allow for an examination of Humboldt's methods of seeing, collecting, and excerpting. It becomes more and more evident that Humboldt's science was "open-ended, situational, and experimental," as Andreas Daum has pointed out for the young naturalist of the 1790s (Daum 2024: 18). Humboldt's numerous unfinished publications, or those that did not survive the draft phase, traces of which can be detected in his papers, underscore this.[3]

Humboldt's scientific biography was profoundly shaped by the voyage across the Americas, undertaken with French botanist Aimé Bonpland from 1799 to 1804. Carmen Götz recently reassessed Humboldt's American travel journals within the context of the naturalist's lifelong scientific paperwork (Götz 2023a; 2023b). These journals are not field notes in the sense of an

1 This paper is a substantially revised version of the article "Reise als Werk. Alexander von Humboldts Beobachtungen, Aufzeichnungen und Entwürfe zur Geographie der Pflanzen (1799–1804)" in the volume *Alexander von Humboldt. Die ganze Welt, der ganze Mensch.* Eds. Ottmar Ette, Barbara Göbel, Tobias Kraft. Baden-Baden: Olms 2024. I would like to thank Carmen Götz, Eberhard Knobloch, and Anne Greenwood MacKinney for giving critical feedback on various drafts of this paper. I am equally grateful to Alberto Gómez Gutiérrez and Tobias Kraft for their comments and support.

2 Dettelbach 1999 (474–467) was the first who proposed a juxtaposition of Humboldtian Science and Humboldt's Science. Andreas Daum has recently expanded this approach to a promising research perspective on Humboldt's scientific biography, consciously employing a lowercase s in the term 'Humboldt's science' (Daum 2024).

3 Cf. for instance Humboldt's collection of notes for an unpublished second edition of his "Ideen zu einer Geographie der Pflanzen" (Päßler 2017).

immediate recording of travel impressions.[4] The travel reports, scientific essays, or collections of ideas included in Humboldt's journals were revised elaborations, which – in keeping with the practice of the time – were based on notes taken directly in the field. At the end of 1805, Humboldt began to compose a detailed "Index général" to his travel journals. The examination of this index sheds a light on the ways Humboldt prepared the scientific information in the travel notes for publication. Sometime during the 1850s, after decades of using and reorganizing the journals, Humboldt had them bound into nine volumes, keeping them largely in the same order as they had been in 1805.

A prime example of Humboldt's science can be found in his research on the geography of plants. Over the course of several decades, Humboldt dedicated himself to investigating the distribution of plants across the globe, employing diverse, sometimes heterogeneous approaches. The genesis of this conceptual framework is closely connected to his American voyage, as the traveler himself acknowledged in the introduction to his seminal publication on this subject: "Above all [...] I owe the material for this work to my journey through the tropics." Humboldt published this *Essay on the Geography of Plants* as the first volume of his travel writings in a German and a French version (Humboldt 1807a, Humboldt 1807b).[5] The author divides the work into two independent parts: He prefaces the book with an introductory treatise – the actual *Essay on the Geography of Plants* – in which he provides a definition of plant geography and sets out its key questions (Humboldt 1807a, 13–35). This is followed by a comprehensive description of the monumental graphic *Tableau physique des Andes et pays voisins* appended to the volume (the remaining pages 33–182). Humboldt wrote a first version of the *Essay,* which he labeled as a *Prospectus* for a future work, in early 1803, during his American voyage. He also drafted the *Tableau physique* around the same time. The neo-Granadian botanist Francisco José de Caldas published the *Prospectus* in a Spanish translation in 1809 (Humboldt 1803/1809).

In this article, I propose a microanalysis of the genesis of Humboldt's concept of plant geography, which can help to improve our understanding of the situational aspects of Humboldt's science. I argue that a close reading of the travel notes on plant geography offers a new approach to the contingent, sometimes contradictory nature of this and other research contributions. In particular, I argue that the often discussed tension between empiricism and aesthetics and the relationship between text and image, so characteristic of Humboldt's science, was reinforced through the experience of observing and writing on the move.

Already between 1791 and 1794, Humboldt had repeatedly articulated the intention to write a treatise on the geography of plants.[6] In an often-cited letter to Friedrich Schiller, written in 1794, Humboldt delineated the comprehensive plan for such a volume.[7] Here, he presents plant geography as an "unfinished part of the general history of the world." He links questions about the geological origins and evolutionary history of plants with the history of humankind: Which

4 For a characterization of the American travel journals, cf. Götz 2023a: 61–64, Ette 2018: viii–xii, Humboldt 2000: 17–19. On the writing practices of European explorers in the field around 1800, cf. Bourguet 2010 and Bödeker 2002.

5 Cf. Fiedler/Leitner 2000: 234–239; 242–245.

6 Humboldt to Paul Usteri, Freiberg, undated (probably fall 1791), (Humboldt 1973: 163–164); Humboldt to Johann Friedrich Pfaff, Goldkronach, November 12, 1794 (Humboldt 1973: 370).

7 Humboldt to Friedrich Schiller, Nieder-Flörsheim, August 6, 1794 (Humboldt 1973: 346–347).

plants did humans spread across the earth? What "impressions of happiness and melancholy" do the various forms of vegetation produce? Humboldt argues for an aesthetic science that goes beyond the mere classification of plants, animals, and rocks. Already at this early stage, five years before he embarked on his research voyage, Humboldt's plant geography is based on the interplay of aesthetic contemplation and empirical observation complemented by a historical perspective on man and nature. In light of these early conceptual considerations, I aim to examine the travel journals with a particular focus on the following questions: How did Humboldt compare his travel observations with his previous notions of natural history? Which concepts receded into the background, which ones did he add to the plant-geographical drafts produced in the course of the journey? What role did personal encounters with inhabitants of the regions visited, especially naturalists, play? These questions may help to avoid the resurgence of a teleological view of Humboldt's scientific oeuvre.[8] I do not argue that there is a straight line between the early concepts on plant geography developed before the journey and the plant-geographical writings published after his return. In his mid-twenties, Humboldt made a few plans for groundbreaking "great works" in geognosy and physiology, which he hoped to present in the years or decades to follow.[9] The results turned out to be far more modest than the announcements, which admittedly he had only articulated in private letters. Nevertheless, Humboldt's letters written in advance of the journey, along with a series of papers on geognosy and plant geography composed in May 1799 show that Humboldt did start his travels with preconceived hypotheses and a working program.[10]

A History of Plants and People (1799–1801)

In his letter to Schiller, Humboldt delineates the migration of plants across the earth as a constituent element of "world history." In this context, Humboldt was employing a definition of the "history of plants" as previously formulated by Carl Ludwig Willdenow in his *Grundriss der Kräuterkunde* (Willdenow 1792: Chap. VI, 345–380). Willdenow, who directed Humboldt's initial botanical studies, conceptualized plant history as encompassing not only the climatic conditions under which diverse forms of vegetation evolved but also the natural migrations of plants and the dispersion of plants by humans. Additionally, he employed the term "geography of plants" to describe the study of the various forms of plant distribution (Willdenow 1792: 376). Between 1799 and 1801, Humboldt developed his ideas on the relationship between climate, vegetation, and human cultural development, as well as the migration of plants throughout Earth's history, in three extended sections of his journal.

In September 1799, or shortly afterwards – three and a half months after his arrival the province of Nueva Andalucía (now Venezuela) – Humboldt wrote a long entry entitled *"History and Geog-*

8 Hanno Beck, for instance, traces a continuum from Humboldt's early vision of Earth Sciences ("physique du monde") during the 1790s to Humboldt's late work *Kosmos* (1845–1862). (Beck 1961: II, 225). On more recent teleological and hagiographic tendencies in Humboldt studies cf. Daum 2024: 14–16.

9 Cf. Humboldt to Carl Freiesleben, Uden, September 10, 1794 (Humboldt 1973: 352); Humboldt to Abraham Gottlob Werner, Bayreuth, December 21, 1796 (Humboldt 1973: 561); Humboldt to Dietrich Ludwig Karsten, Bayreuth, December 12, 1796 (Humboldt 1973: 498).

10 On this manuscript, which Humboldt addressed to Carl Freiesleben, cf. Beck 1957. Cf. also Humboldt to Moses Friedländer, Madrid, 11. April 1799 (Humboldt 1973: 657–659).

raphy of Plants. Agriculture."[11] In it, he collected information on the natural migration of plants between America and Asia and the dissemination of cultivated plants. In this early American text, Humboldt refers to a manuscript on the same subject pertaining to the European context. At this point, the link to the project preparation undertaken prior to the journey remains direct.[12] The traveler compares the climate and vegetation of the northern hemisphere with his observations in the American tropics. The few species of coconut palms, banana trees, and other useful plants that grew in the tropics provided an abundant and convenient food source within a limited space. For this reason, Humboldt concluded, the inhabitants of this climatic zone devoted themselves primarily to horticulture: "The brute man of the South seeks consumption nearby and the rich world that surrounds him provides it."[13] While in the American tropics nature provided abundant food and thus tended to inhibit culture and socialization, according to Humboldt, the inhospitable climate of the northern climatic zones promoted the "culture of the human race" through the necessary competition between the physical and intellectual powers of man and the resulting "industriousness" and "perfection of agriculture": "Thus the world of plants has had an effect on the human race, and the latter reciprocally on the former."[14] Considerations on the influence of climate and vegetation on humans were not new. They can be found, for example, in Johann Gottfried Herder's *Ideas on the Philosophy of the History of Mankind.*[15] However, in a second note, probably written between November 1799 and February 1800 and entitled *"Phys[ische] Pflanzen-Geographie-Geschichte u[nd] [-]Beschreibung"* (*"Physical plant-geography-history and -description"*) Humboldt abandoned the tropes of the European Enlightenment.[16] These are now replaced by the concrete example, drawn from his own observation, of the cultivation of small plots of land (*conucos*) by enslaved families, whose fate is alleviated by the favorable vegetation conditions of the tropics:

> The tropical soil (Valle de Arajua) is so fertile that Negro slaves, who are each given a piece of land and who only have to work 2 days a week (Saturday and Sunday), produce so much pisang, dioscorea and batatas in their small Conucos that they have enough to eat year after year with their wives and children. Ipse vidi. [...] This is not to describe the condition of the slaves as appealing, but to describe the fertility of the earth.[17]

11 "Geschichte und Geographie der Pflanzen. Akkerbau" Humboldt, Alexander von: Voyage d'Espagne aux Canaries et à Cumaná Obs. astron. de Juin à Oct. 1799 [= Tagebücher der Amerikanischen Reise, Bd. I]. Eds. Carmen Götz and Ulrike Leitner, in collaboration with Sandra Balck, Linda Kirsten, Ulrich Päßler, Eberhard Knobloch, Oliver Schwarz, Laurence Barbasetti and Regina Mikosch. In: *edition humboldt digital.* Ed. Ottmar Ette. Berlin-Brandenburgische Akademie der Wissenschaften, Berlin. Version 10, July 2, 2024 (henceforth: *edition humboldt digital,* ART I). URL: https://edition-humboldt.de/v10/H0016412. Folio: https://edition-humboldt.de/v10/H0016412/50r.

12 Ibid: "to be compared with the MSS in Europe, without which these sheets must often be incomprehensible."

13 Ibid., fol. 50v (https://edition-humboldt.de/v10/H0016412/50v).

14 Ibid., fols. 50v (https://edition-humboldt.de/v10/H0016412/50v), 53r (https://edition-humboldt.de/v10/H0016412/53r).

15 Cf. for instance, the chapter "Das Pflanzenreich unserer Erde in Beziehung auf die Menschengeschichte" in Herder's *Ideen* (Herder 1784–1791: 1. Teil, 2. Buch, II. Kap., 65–78). The influence of Herder on Humboldt's plant geography is discussed by Mook 2012: 133–157.

16 Staatsbibliothek zu Berlin – Preußischer Kulturbesitz (henceforth: SBB-PK), Nachl. Alexander von Humboldt (Tagebücher), III, fols. 64r–68r (http://resolver.staatsbibliothek-berlin.de/SBB0001527400000125).

17 Ibid., fols. 64v–65r (http://resolver.staatsbibliothek-berlin.de/SBB0001527400000126).

Subsequently, Humboldt provides an account of sixteen useful plants of the *Conucos* as observed by Bonpland and himself, accompanied by comprehensive information on their cultivation and preparation (Fig. 1).[18]

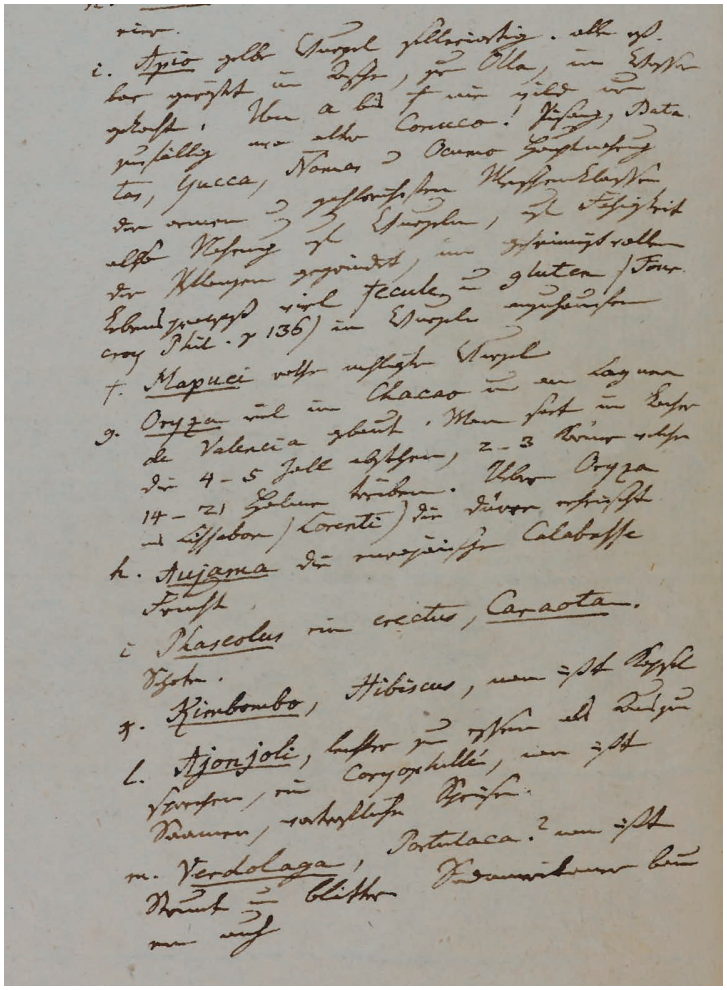

Fig. 1: Alexander von Humboldt: List of useful plants cultivated in the *Conucos* (1799/1800), including *ajonjolí* (sesame): "easier to eat than to pronounce". SBB-PK, Nachl. Alexander von Humboldt (Tagebücher), III, fol. 65v.

Humboldt returned to the reflections on the connection between climate, vegetation, and human history in the first volume of his travelogue *Relation historique* in 1817.[19] There he contrasts the cultural landscapes of the temperate climate in mid-latitudinal Europe with the geographically and socially isolated settlements of the tropics of America. However, the description no longer serves to illustrate a theory of stages in the history of civilization; Humboldt instead ventures into the aesthetics of landscape. Different forms of agricultural cultivation not only shaped the physical aspect a region, but also the character of their inhabitants (Humboldt 1814–1825, I: 359–361). Humboldt condensed this idea into a theory of compensation in his 1803 preliminary announcement of his plant geography work and in his 1807 *Essay on the Geography of Plants.* The sparseness of nature in the temperate zone stimulated the "magic of imitative arts," which led the people of the north in spirit to the most distant parts of the world. "Those whose feelings are sensitive to this magic, whose minds are educated enough

18 Ibid., fols. 65r–65v (http://resolver.staatsbibliothek-berlin.de/SBB0001527400000127).

19 On the publication of the first volume of the *Relation historique* (Humboldt 1814–1825, I), cf. Fiedler/Leitner 2000: 77.

to embrace nature in all its activities, create an inner world for themselves in the solitude of a barren heath" (Humboldt 1807b: 51–52).[20]

Humboldt's main interest in the two above-mentioned episodes of his plant-geographical writings from 1799 and 1800 is the distribution of cultivated plants across the globe by humans. He notes information on the dissemination of maize and coconut palms, originally based on his reading of European authors such as Carl von Linné, Carl Peter Thunberg, and Georg Forster. These names elucidate once more how closely Humboldt's early thoughts on the geography of plants were "linked to the Enlightenment Science of Man."[21] However, Humboldt combines these European notions now with his own observations and information from local, albeit unnamed, interlocutors about the reintroduction and acclimatization, growing conditions, and spread of cultivated plants.[22]

Probably in April 1801, after his first sojourn in Cuba, during a stay in Cartagena or Turbaco as a guest of the merchant and scholar José Ignacio de Pombo, Humboldt took up the problem of humankind's role in the migration of plants for a third time. Probably making use of his host's extensive library, Humboldt studied Francisco Javier Clavijero's *Storia antica de Messico.* In the journal, he notes the author's thesis that bananas, oranges, and lemons had already been cultivated in Mexico before the arrival of the Spanish.[23] Here, Humboldt makes reference to his earlier journal texts on the history of plants, which he had left behind in Havana.[24] He reiterates the significance of determining "which plants have followed people everywhere," as "plants show where people came from." Additionally, he confirms based on his own observations of the vegetation on Cuba and along the coast of the *Tierra Firme* that citrus trees grew wild in these regions. He associates this with the long history of plant cultivation in these areas and the higher population density and social organization observed on islands in general.[25] Nevertheless, he now concludes that no migration history of the plants can be deduced from his own observations, oral reports from locals, and written sources: First, the "peoples who invaded America" long before the Spanish arrived could have introduced plants. Second, since 1492, "all the nations of the world had settled here" and brought their "native flora" with them.[26]

In his later writings on the geography of plants from 1803 and 1807, Humboldt limited himself to describing two major plant migrations instigated by humans as traceable in historical

20 Cf. Humboldt 1803/1809: 139.

21 Anthony 2018: 33; Gómez Gutiérrez 2023: 77–79.

22 *edition humboldt digital,* ART I: fols. 53v (https://edition-humboldt.de/v10/H0016412/53v), 54r (https://edition-humboldt.de/v10/H0016412/54r), 54v (https://edition-humboldt.de/v10/H0016412/54v).

23 SBB-PK, Nachl. Alexander von Humboldt (Tagebücher), II/VI, fol. 96r (http://resolver.staatsbibliothek-berlin.de/SBB0001527300000185). Clavijero 1780/1781, I: 48–50.

24 SBB-PK, Nachl. Alexander von Humboldt (Tagebücher), II/VI, fol. 95r (http://resolver.staatsbibliothek-berlin.de/SBB0001527300000183).

25 Ibid. Such an idea can already be found in Johann Reinhold Forster's travelogue, among others: "Isles are, on account of their circumscribed size, more apt to promote and accelerate civilization, than large continents […]" (Forster 1778: 343–346).

26 SBB-PK, Nachl. Alexander von Humboldt (Tagebücher), II/VI, fols. 95v (http://resolver.staatsbibliothek-berlin.de/SBB0001527300000184), 95r (http://resolver.staatsbibliothek-berlin.de/SBB0001527300000183).

sources. Using the writings of Willdenow and the pomologist Friedrich Sickler, he described the spread of cultivated plants from Asia to Europe during antiquity and the exchange between Europe and America since 1492.[27]

In the three texts written on the move between 1799 and 1801, Humboldt relegates the topic of earth historical shifts in plant habitats to the margins, since it was not a subject he could explore using immediate observations in the field. Right at the beginning of the journey, he thus shifts the search for hypotheses on non-human-induced plant migration to a future research agenda. In the collection of ideas entitled *Physical plant-geography-history and -description* (around 1799/1800), he suggests a more detailed study of the flora of the Azores, as this archipelago was of great importance for the migration of plants and for the question of the existence an ancient continent ("Inselland") between Europe and America.[28] Referring to observations by Georg Forster, he states that grasses and aquatic plants were able to spread furthest across the globe.[29] In the third collection of ideas from 1801, he repeats his conviction already expressed in the first entries of the American journal that Africa and South America were once connected, but had already been separated at a time when "nature had created neither plants nor animals," as the fauna and flora of the two continents were very different.[30] Humboldt would incorporate this idea without modification into his *Essay on the Geography of Plants* (1807), just as he would with the hypothesis of a former connection of Africa and Europe at the Strait of Gibraltar, which he had expressed in a journal entry prior to embarking on his American voyage.[31] Humboldt also adopted virtually unchanged the assumption that the fossilization and imprints of plants in coal strata could provide information about the history and distribution of plants; an idea suggested by Willdenow in his *Grundriss der Kräuterkunde* and repeated by Humboldt in his letter to Schiller in 1794, but not pursued during the American journey.

In his published writings on plant geography, Humboldt does not succeed in taking plant migration – which in 1794 formed an essential part of the plant geography project both in its human and earth-historical dimension – beyond the original postulations. In 1817, in the first volume of the *Relation historique,* Humboldt once more recapitulated the major research questions of plant geography (Humboldt 1814–1825, I: 600): How can it be explained that the same plant species can be found in places separated by oceans or mountain ranges? Why, on the other hand, do places with similar climatic conditions produce different plant species, which in turn result in similar vegetation formations? Humboldt explicitly rejects any hypotheses about the origin of things ("*l'origine des choses*") in general and the history of plants in particular as pure speculation. Instead, he states that the natural scientist fulfills his task solely by describing the laws according to which nature distributes plant forms (Humboldt 1814–1825, I: 603). Humboldt

27 Humboldt took information on the first migratory movement during European antiquity from Friedrich Sickler's *Allgemeine Geschichte der Obstkultur* (Sickler 1802). Cf. Humboldt 1807a: ix.

28 SBB-PK, Nachl. Alexander von Humboldt (Tagebücher), III, fol. 64r (http://resolver.staatsbibliothek-berlin.de/SBB0001527400000125).

29 Ibid., p. 64v. Cf. also Willdenow 1792: 368–369.

30 SBB-PK, Nachl. Alexander von Humboldt (Tagebücher), II/VI, fol. 94r (http://resolver.staatsbibliothek-berlin.de/SBB0001527300000181). Cf. also "Geognosie v[on] America," *edition humboldt digital,* ART I, fol. 33r (https://edition-humboldt.de/v10/H0016412/33r).

31 Humboldt 1807a: 17. Cf. SBB-PK, Nachl. Alexander von Humboldt (Tagebücher), V, fol. 79r: "Ideen 1799 [?]" (http://resolver.staatsbibliothek-berlin.de/SBB0001527800000161).

is referring to botanical arithmetic, a new approach to plant geography that he used around 1815 to statistically study the global distribution patterns of plant families (Humboldt/Bonpland/Kunth 1815–1825, I: iii–lviii).

Dissecting the Whole of Nature – And Re-Creating It (1799–1801)

In his programmatic letters to Schiller and Pfaff in 1794, Humboldt had described plant geography as a project of the senses, as he wanted to investigate the "influence of the plant world on the sensitive man." In a letter to his brother Wilhelm on July 16, 1799, Humboldt described the affective effect of the flora and fauna of the tropics on himself and his travel companion Bonpland: "So far, we have been walking around like fools […]. Bonpland assures me that he will go out of his mind if the wonders don't stop soon."[32] Humboldt noted an even deeper emotional reaction a few weeks later in his report on the first inland excursion: "Just as one leaves the coast, one enters a new, livelier world. What lavishness of plant growth, what darkness under the densely woven canopy of leaves."[33]

In the field report, the collector's ineffectiveness in the face of the abundance of plant forms takes its place alongside the sensory indulgence:

> Of the tenth part of the plants that surrounded us, we did not even suspect the genus. Bonpland's complaint that our supply of paper could not contain this abundance almost hindered my enjoyment. Our plant tins and handkerchiefs were soon filled, and from the Impossibile Mountain we sent a messenger to Cumaná for 800 new sheets of paper.[34]

Humboldt follows up this admission of the explorer's sensory and information overload with an attempt to resolve this dilemma through aesthetic means: "On this path, I had manifold reason to reflect on plant forms and that which is peculiar to tropical nature." Humboldt believed he recognized the difference between the "tropical world," on the one hand, and nature "in the north" and the "African world" on the other, in the incomparably greater quantity of "plant forms" located in the tropics. "In the tropical world, everything is united and in the most wonderful contrast, impressive and characterized through proximity and mass." In the temperate zone, for example, there are "hardly 2–3 plant forms, conifers, deciduous trees, few pinnated trees, no palm form, no aloe or cactus or pisang form." In Africa, the cactus and aloe forms dominate, appearing "solemn, but more rigid, dead."[35]

32 Alexander to Wilhelm von Humboldt, Cumaná, July 16, 1799 (Humboldt 1993: 42).

33 Voyage à Caripe 1799 [= Tagebücher der Amerikanischen Reise, Bd. II/VI, Heft 3, Bl. 110–131]. Ed. Carmen Götz in collaboration with Ulrich Päßler. In: *edition humboldt digital.* Ed. Ottmar Ette. Berlin-Brandenburgische Akademie der Wissenschaften, Berlin. Version 10, July 2, 2024 (henceforth: *edition humboldt digital,* ART II/VI, Voyage à Caripe). URL: https://edition-humboldt.de/v10/H0019154. Folio: https://edition-humboldt.de/v10/H0019154/112v. Cf. Humboldt 2000: 139 (September 4 to 24, 1799).

34 *edition humboldt digital,* ART II/VI, Voyage à Caripe, fol. 113r (https://edition-humboldt.de/v10/H0019154/113r).

35 Ibid. fol. 113v (https://edition-humboldt.de/v10/H0019154/113v). Underlining in the original.

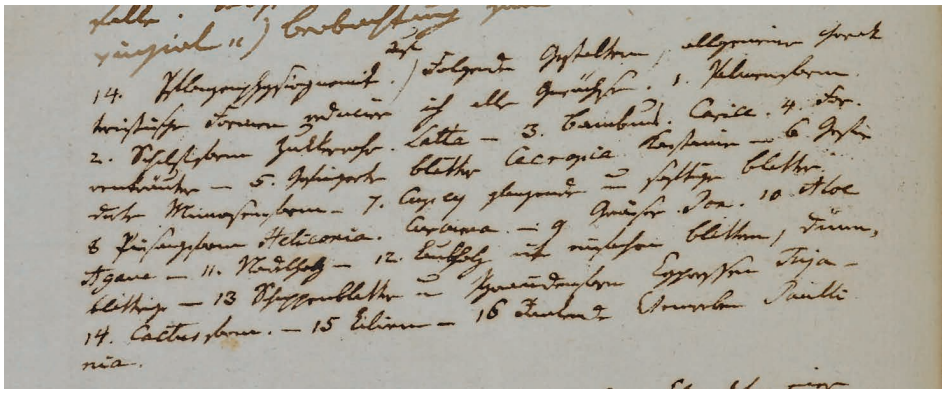

Fig. 2: Alexander von Humboldt: "14. plant physiognomy" (1799). SBB-PK, Nachl. Alexander von Humboldt (Tagebücher), III, fol. 52v.

In September 1799, Humboldt thus presented the concept of principal physiognomic forms for the first time, which he did not form according to the flower, as in the conventional taxonomic systems, but "according to parts, which give character through mass and shape."[36] At the same time, he acknowledged the difficulty of finding suitable names for these principal forms of the Earth's plant kingdom. Humboldt tackled this problem in December 1799 at the earliest. Around this time, he drew up an enumerated list entitled "Ideen. Materialien." In the final point of the list, Humboldt applies the term physiognomy to the analysis of plant and vegetation forms, which he had previously only used to describe landscapes and geological formations (Fig. 2).[37] In this moment of notation, which seems to have been added in as an afterthought and does not follow from any previous passage and is, intially, not taken up again, Humboldt defines sixteen basic physiognomic forms into which all known plant species could be classified, for example the forms of palm trees, reeds, sugar cane, conifers, and deciduous trees. The relationship between the shapes determines the "character of an area," the overall impression of a landscape. As in his field report of September 1799, he states that the splendor of tropical vegetation is based on the fact it unites almost all plant forms.

Based on his early experience of the tropics Humboldt formulated a new botanical classification system – the physiognomy of plants –, which was intended as a comparative tool for analyzing earth's vegetation. Here, Humboldt drew on a model of natural classification of organisms according to basic forms and their overall habitus (*"ganzer Habitus"*), which Johann Friedrich Blumenbach had taught him in Göttingen (Lenoir 1981: 171–173). Humboldt made his plant-physiognomic ideas public in the manuscript *Prospectus* addressed to José Celestino Mutis in 1803, where he presented ten plant forms. While the names and number of these principal forms vary across the publications *Essai sur la Géographie des Plantes* (1805/1807, fifteen forms), *Ideen zu einer Physiognomik der Gewächse* (1806, nineteen forms) and *Ideen zu einer Geographie der Pflanzen* (1807, seventeen forms), the overall concept remained unchanged.

Humboldt developed the heuristic approach of combining scientific observation and aesthetic perception to make the character of different forms of vegetation empirically tangible and classifiable. Here, Humboldt is exploring the relationship between the individual phenomena

36 Ibid. On Humboldt's concept of plant physiognomy, cf. Hagner 1996 and Robert 2008: 46–47.

37 SBB-PK, Nachl. Alexander von Humboldt (Tagebücher), III, fols. 50r (http://resolver.staatsbibliothek-berlin.de/SBB0001527400000097), 52v (http://resolver.staatsbibliothek-berlin.de/SBB0001527400000102). Cf. Robert 2008: 47.

and the whole of nature, which through their interplay, constitute a 'total impression' (*"Totaleindruck"*). He "dissected," as it were, this total impression of nature, to take up a formulation by Humboldt in the *Versuche über die chemische Zerlegung des Luftkreises* (Humboldt 1799: 151).[38] Humboldt's plant physiognomy thus immediately raises a follow-up question: How can the total impression of the landscape be gained anew from this combination of science and aesthetics, how is it possible to once more "embrace nature with one glance" (Humboldt 1806: 11)?

In March 1801, Humboldt and Bonpland returned from Havana to the South American mainland. Setting foot once again on the *Tierra Firme,* near the mouth of the Río Sinú on the Caribbean coast of New Granada, Humboldt was prompted to reflect at length on the possibility of an aesthetic categorization of landscapes. He emphasizes the subjectivity of any judgement, as "upon landing, every coast appears to be a charming landscape to the voyager."[39]

Here, the impression of landscape is thus initially understood subjectively and situationally, even biographically. As evidence, Humboldt lists a number of his European and American impressions of nature, whose character he immediately categorizes according to the criteria "friendly and smiling" (*"freundlich und lachend"*), "majestic and grand" (*"majestätisch und groß"*), and "solemn and terrifying" (*"ernst und schreckklich"*). The most graceful and charming landscapes were those in which several of these characters are mixed, such as the cataracts of the Orinoco, but also "the valley of Wernigerode" in the Harz Mountains.[40] One might say that Humboldt was drawing upon an aesthetic tension between the *beautiful* and the *sublime* in the landscape.[41] Such landscapes, which offer "the view of great energy," are characterized by the fact that their essence eludes the observer the more one "dissects" their "energy, their beauty." Humboldt thus resumes here the attempt to capture nature through the formation of (physiognomic) categories first begun at the outset of his American voyage in 1799. These passages echo the reflections on art in Wilhelm von Humboldt's *Ästhetischen Versuchen* (Humboldt, W. 1799), which Alexander had received in Havana just a few months earlier.[42] Ultimately, the traveler concedes that an exacting analysis of landscapes, unlike that of human works of art, is not possible and stops writing mid-sentence.[43]

Leaving behind the attempts at a global comparative analysis of landscapes, Humboldt returns to the daily business of recording the taxonomic findings of the palms at the mouth of the Río Sinú on the next page of the sheet. He follows this with a multi-page overview of the palms

38 "[…] den Totaleindruck so vieler gleichzeitigen Reize zu zergliedern." Cf. Dettelbach 1999: 480.

39 SBB-PK, Nachl. Alexander von Humboldt (Tagebücher), II and VI, fol. 203r (http://resolver.staatsbibliothek-berlin.de/SBB0001527300000393): "Río Sinú".

40 Ibid., fol. 203v (http://resolver.staatsbibliothek-berlin.de/SBB0001527300000394).

41 On the dichotomous poles of the beautiful and the sublime in Humboldt's ideal of "Totaleindruck" ("total impression") of nature cf. Böhme 2019: 591–592.

42 Alexander von Humboldt to Karl Ludwig Willdenow. Havanna, February 21, 1801. Ed. Ulrich Päßler in collaboration with Klaus Gerlach and Ingo Schwarz. In: edition humboldt digital. Ed. Ottmar Ette. Berlin-Brandenburgische Akademie der Wissenschaften, Berlin. Version 10, July 2, 2024. URL: https://edition-humboldt.de/v10/H0001181. Folio: https://edition-humboldt.de/v10/H0001181/5v.

43 SBB-PK, Nachl. Alexander von Humboldt (Tagebücher), II und VI, fols. 203v (http://resolver.staatsbibliothek-berlin.de/SBB0001527300000394), 204r (http://resolver.staatsbibliothek-berlin.de/SBB0001527300000395).

of America, which he compares with African and Asian palm species.[44] Given the astonishing variety of forms in this plant family, he laments the inadequacies of conventional botanical descriptions and classification systems. Although they analyzed flower parts and sometimes described leaf shapes, they could not capture the "character" and form of a plant:

> It is a branch of another, entirely unexplored discipline, which belongs half to the field of aesthetics [...]. But where is the botanical painter who knows how to express and depict the character of trees, who walks for days in a beech forest to study the nature of the tree trunk and knows how to unite everything individually into a group?[45]

At this point, Humboldt takes up the idea of plant physiognomy again and drafts a plant-geographical concept, which, through the interplay of data collection and visualization, captures not only plant forms but also the overall aesthetic impression of a vegetation:

> This is the work of a more aesthetic class of people, the Waitsch in Braunschweig and the one in Vienna, Webber in London ... Goethe has an *Italian Journey* in this style, in which the originality of human and plant nature is vividly depicted, as if stolen from a mirror. What a great work, as important to the description of nature as to the arts, indeed to poetry as to painting, could be produced if a tasteful, nature-loving traveler united with a sensitive, nature-perceiving painter, traversed the world and depicted for us in individual groups the character of the palm trees, the bamboo, the cecropia ...![46]

Here Humboldt reflects on the artistic and literary knowledge he had acquired prior to his journey, including the early aesthetic influences he had encountered in Weimar and Jena. To Goethe he would dedicate the German edition of his *Essay on the Geography of Plants.*[47]

John Webber, who participated in James Cook's final circumnavigation of the globe and who is also referenced in the journal passage, exemplifies the practice, already customary in the eighteenth century, of hiring illustrators and painters to accompany naturalists on significant expeditionary voyages. In Humboldt's case, however, the artist's role extends beyond that of an illustrator. He was particularly interested in the integration of aesthetic perception and empirical data, which is embodied by the alliance of artist and naturalist. In the *Prospectus* of 1803 – and similarly in the *Essay* of 1807 – Humboldt emphasized the value of the artistic description of nature: Only the poets and painters could portray the true beauty of the tropics (Humboldt 1803/1809: 139).

In the chapter "Ideen zu einer Physiognomik der Gewächse" in the *Ansichten der Natur* (Views of Nature) in 1808, Humboldt also incorporates the aforementioned journal entry describing the palms of the world into a lengthy footnote in which he elucidates the palm form as the first of the nineteen principal forms. He explicitly presents these observations as travel notes.

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44 Ibid. fol. 204v (http://resolver.staatsbibliothek-berlin.de/SBB0001527300000396).

45 Ibid. fols. 210v (http://resolver.staatsbibliothek-berlin.de/SBB0001527300000410), 211r (http://resolver.staatsbibliothek-berlin.de/SBB0001527300000411).

46 Ibid.

47 Humboldt to Goethe, Berlin, February 6, 1806 (Goethe 1909: 297). Cf. also Päßler 2019. On Humboldt's treatment of the literary, aesthetic, and art-historical debates in the German-speaking world around 1800, cf. Daum 2019.

In this way, plant physiognomy as a category of aesthetic landscape analysis is linked back to scientific analysis in the field. The author illustrates the heuristic approach with which he aims to make the character of various forms of vegetation empirically tangible and classifiable. This is achieved by reorganizing and rearranging journal passages and trains of thought, some of which have been heavily revised, and some of which – such as in this last case – have been adopted almost verbatim. This combination of scientific observation and aesthetic contemplation is presented as a single entity.

In his later work, Humboldt persisted in his efforts, initiated in 1794, to integrate the domains of aesthetics, human history, and natural science. In the second volume of *Kosmos,* Humboldt presents a history of landscape poetry and landscape painting, wherein he ascribes a rather functional role to the arts as a "means of stimulating the study of nature." The second principal theme of the volume is directly related to this: a history of the physical worldview ("*physische Weltanschauung*"), that is, the perception and knowledge of nature from antiquity to the eighteenth century. As the empirical basis of this study the naturalist Humboldt meticulously compiled and evaluated historical sources (Humboldt 1845–1862, II: 4–92).

On the Path to the Tableau Physique (1801–1803)

On April 6, 1801, Humboldt and Bonpland embarked on their journey from Turbaco near the American Caribbean coast, following the course of the Río Magdalena upstream until reaching Honda. During this voyage, Humboldt resumed his observations of vegetation physiognomy. In his notes, he underlines the plants that characterize the landscape or are most common along the river. The prevalence of the plants is indicated by the number of underlines. (Fig. 3)

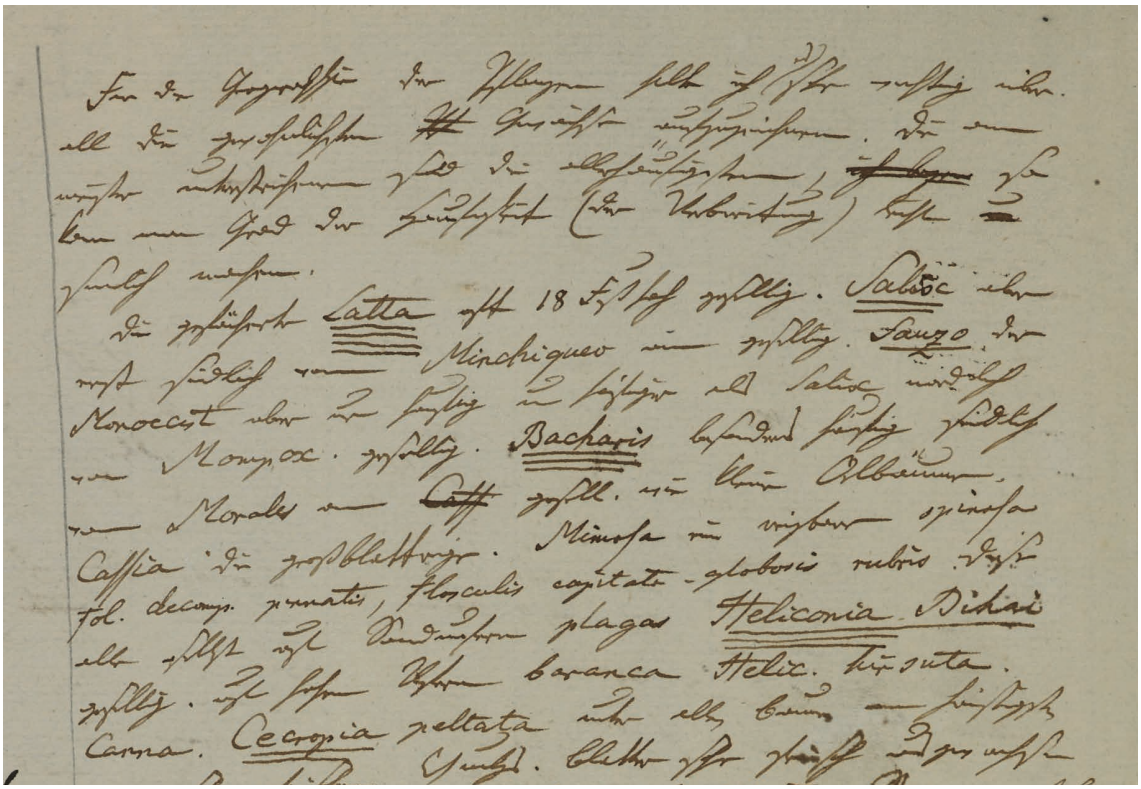

Fig. 3: Alexander von Humboldt: "For the geography of plants I consider it very important to record the most common plants everywhere" (1801), SBB-PK, Nachl. Alexander von Humboldt (Tagebücher), VII a/b, fol. 20v.

They continued on to Santa Fé de Bogotá, Popayán, and Quito, where they arrived on January 6, 1802. As Humboldt wrote to his brother Wilhelm, the purpose of this leg of the journey was (1) to map South America north of the Amazon, (2) to meet in Bogotá the botanist José Celestino Mutis, whose extensive plant collections Bonpland and Humboldt had already learned about on the first leg of their journey, and (3) to fulfill "the desire to climb the immense Cordillera of the Andes."[48]

On the journey from the Caribbean coast to Bogotá, Humboldt made numerous barometric altitude measurements, which he compiled in a geological cross-section of the Río Magedalena valley entitled *Nivellement barométrique du terrain depuis Carthagène à Santa Fé,* published in Madrid in 1802 (Humboldt 1802). The mining engineer Humboldt developed this style of profiles from the vertical cartography of mine shafts.[49] In his journal, Humboldt combined the elevation data from his barometric measurements on the journey from Honda to Bogotá (June 22 to July 8, 1801) with information on the plants characteristic of the respective elevations, such as Caryota, Latta (*Gynerium sagittatum*), sugar cane and bamboo in Salto del Fraile, and *Weinmannia pinnata* in Cune (Fig. 4).[50]

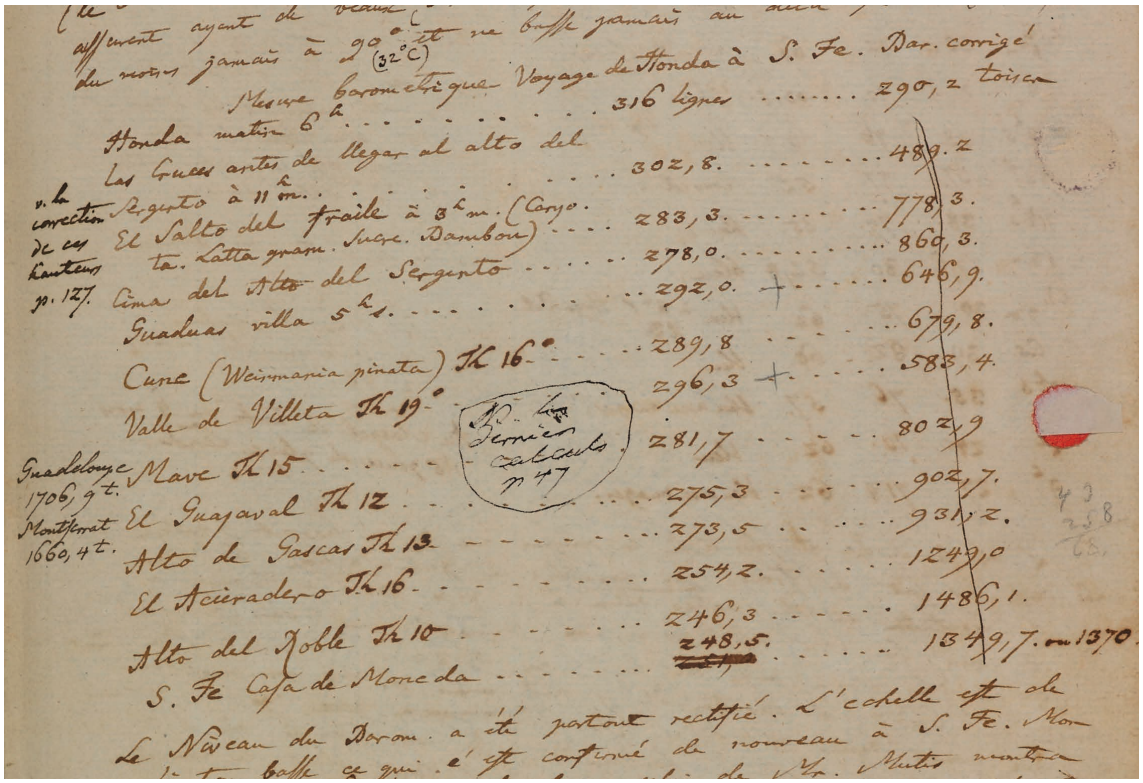

Fig. 4: Alexander von Humboldt: "Mesure barométrique. Voyage de Honda à S. Fé" with details of some plants characteristic of the altitude levels in question (1801), SBB-PK, Nachl. Alexander von Humboldt (Tagebücher), VII a/b, fol. 75r.

48 Alexander to Wilhelm von Humboldt, Contreras, September 21, 1801 (Humboldt 1993: 148).

49 "La Projection la plus instructive pour la Géognosie est la verticale. J'ai conçu l'idée de figurer des pays entiers comme on représente une mine." Beck 1958: 34 and 37; cf. also Anthony 2018.

50 SBB-PK, Nachl. Alexander von Humboldt (Tagebücher), VII a/b, fol. 75r (http://resolver.staatsbibliothek-berlin.de/SBB0001527A00000119): "Mesure barométrique[.] Voyage de Honda à S[anta] Fé. Bar[omètre] corrigé".

This table is presumably the earliest evidence of the connection between altitude measurements and vegetation zonations in Humboldt's American journal. Therefore, it is of interest to narrow down the period in which it was written. An indication of an early recording of this itinerary of the route from Honda to Bogotá can be found in the subsequent addition of the altitude measurements of the Guadalupe and Monserrate mountains, which Humboldt and Bonpland only visited on excursions during their stay in Bogotá (July 25 and August 15, 1801). The elevation data were incorporated into the aforementioned profile between Cartagena and Bogotá, which Humboldt transmitted to Madrid prior to his departure from Bogotá. Accordingly, the latest possible date for this act of writing would be the conclusion of his stay in Bogotá on September 8, 1801. The profile drawing and map commentary are of significant importance with regard to the genesis of the *"Tableau physique des Andes et pays voisins."* Already at this point, Humboldt had established a connection between his South American measurements and altitude data from other regions of the world. Copies of Humboldt's sketch of the profile were already in circulation in Bogotá in 1801, before publication. In addition to indicating the peaks of Chimborazo and Mont Blanc, among others, as reference points, the sketch also depicts a vegetation zone, albeit in a rather schematic manner (Fig. 5).

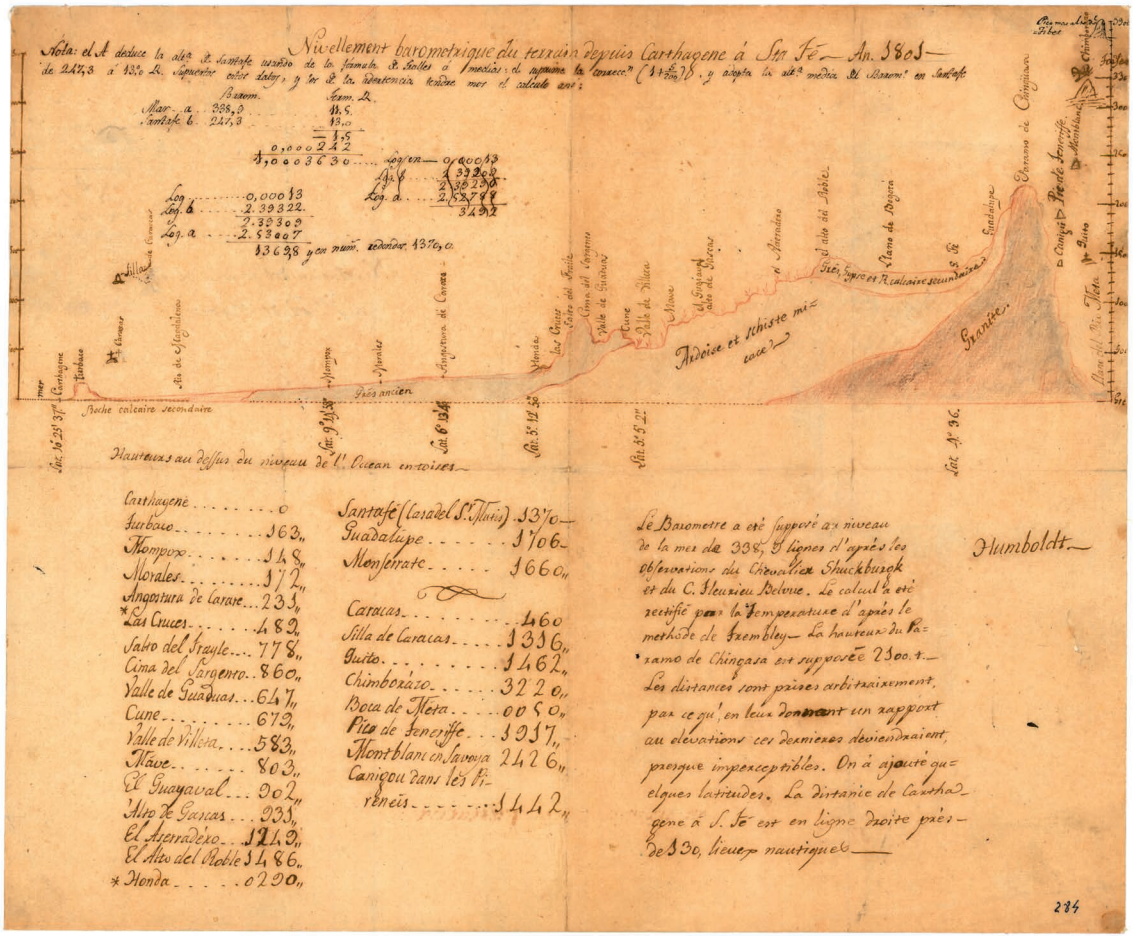

Fig. 5: Alexander von Humboldt: "Nivellement barométrique du terrain depuis Carthagène à Santa Fé," copy by Santiago Pérez de Arroyo Valencia for Francisco José de Caldas (1801). Archivo Cartográfico y de Estudios Geográficos del Ejército, Ministerio de Defensa, España, Ar.J-T.7-C.1_10Bis.

On September 8, Humboldt and Bonpland set off for Quito. In the report of an initial phase of the journey, from Bogotá to Ibagué, Humboldt made the following observation on September 12, 1801:

> Paying as much attention to the geography of the plants as to the altitude of the place, we noticed with interest that with each passing day, the plants of the Llano de Bogotá left us and new ones from the hot regions of the world (“*der heißen Erdstriche*”) arrived.[51]

Humboldt reiterates this observation of the discernible stratifications in vegetative composition across the topographic features of the Andes of New Granada on multiple occasions throughout his travel accounts, spanning from September to December 1801. Upon entering the Andes in September 1801, Humboldt’s plant geography project underwent a paradigmatic reorientation. In addition to the physiognomy of plants and the related question of depicting and comparing landscape types, the vertical projection of vegetation levels now took its place. Humboldt brought with him from Europe an understanding of mountains as a miniature world that provided the naturalist with an opportunity to study a variety of geoscientific and biological phenomena in an environment akin to a laboratory setting. He was acquainted with the research conducted on the altitudinal structure of mountains, as exemplified by the work of Louis-François Ramond de Carbonnières in the Pyrenees (Ramond 1789, II: 329–346). In his capacity as a field researcher, Humboldt himself had previously described and practically implemented the mountain slopes of the Berchtesgaden Alps in 1798 for the purpose of comparative meteorological and botanical data collection at various altitude levels (Humboldt 1799: 155).

Humboldt was not the *first* European field researcher who observed and documented the distinctive vegetation patterns at varying altitudes in the Andes. Charles-Marie de La Condamine describes the “climats divers par étages” and vegetation levels of the province of Quito in the account of his American travels during the 1740s, to which Humboldt repeatedly refers in his journal (La Condamine 1751: 48).[52] Humboldt, moreover, was by no means the only researcher *of his time* interested in vegetation patterns. His and Bonpland’s research was significantly influenced by South American botanists whom they met during their voyage. In Bogotá, the travelers worked with José Celestino Mutis from June to September 1801. On January 2 or 3, 1802 they made the acquaintance of Francisco José de Caldas, who had been engaged in field research on the agricultural products of the northern Andes for several years. Probably after the exchange of ideas with Caldas had begun, Humboldt penned a journal entry titled *“Géographie des Plantes. Fragmens”* covering the journey from Popayán to Quito (November 27, 1801 to January 6, 1802). This text, in essence, encapsulates the zonation concept that he will later visually realize in the *Tableau physique.*

> In no other land does the influence of climate and location on vegetation make such a deep and invigorating impression on the mind (*“Geist”*) as in the Andes. On the way from Popayán via Almaguer and Pasto to Quito, one descends several times a day from the summit of the Páramos into the valleys approaching the sea. With each step, the climate and air pressure change, and with them the plant forms, not only because the same tree

51 Ibid. VII a/b, fol. 93r (http://resolver.staatsbibliothek-berlin.de/SBB0001527A00000155).

52 On La Condamine’s influence on Humboldt’s concept of plant geography, cf. Renner et al. 2023: 100–102. The observations of La Condamine and Humboldt regarding the zonation of Andean vegetation are consistent with the concept of the Andes as a microcosm in which global climates and products converge, as espoused by local naturalists (Cañizares-Esguerra 2005: 152–163).

> spreads its branches differently at 200 than at 1500 t[oises] altitude, but also because other plant species clothe the plain, others the foothills, and others the altitude itself.[53]

As in the plant-geographical notes of the previous sections of the journey, Humboldt's interest here is initially in the aesthetic effect of vegetation on humans. In this context, *'Geist'* is to be understood in accordance with the usage at the time as a 'unity of sensibility and thought' (Goethe Wörterbuch 1978–2019, III: Sp. 1428). Consequently, Humboldt proceeds to analyze his impression in a process of "dissection": The constant change in plant and vegetation forms following a vertical course depending on altitude and growing conditions constitutes the "peculiar beauty of Andean nature," while the tropical vegetation of the plains is characterized by the juxtaposition of the diverse forms. Humboldt proceeds to define four altitude levels between 1000 and 2400 toises (approx. 1950 to 4800 meters), for each of which he lists the scientific names of characteristic plants that can be found between 10 degrees north and 10 degrees south latitude. He designates the two lower vegetation levels after the plants that typify them ("1000 to 1400 toises. Cinchona region"; "From 1400–1800 t. Region of the Frailejon"). In his descriptions of the final leg of the journey to Quito, Humboldt continues to categorize these vegetatative "strata" according to the dominant plant species in the landscape. He describes the descent from the "vegetation of the Páramos" to the "region of the Croton and Paullinias" and refers to the "climate of the Cinchona."[54]

Humboldt and Bonpland subsequently accompanied Francisco José de Caldas on his travels in the province of Quito over the following months of 1802. Similarly to Humboldt, the botanist Caldas conducted altitude measurements, which he subsequently shared with his Prussian colleague. Humboldt's journal contains multiple references to the two scholars engaged in discourse pertaining to instruments and methodologies.[55] Caldas' interest in the study of the altitudinal distribution of useful plants must have resulted in an exchange on this topic during their joint fieldwork. Humboldt's journal entries and the letters, project proposals, and manuscripts that he and Caldas sent to Mutis in 1802 and 1803 demonstrate that their interests in plant geography were nearly identical (Gómez Gutiérrez 2016, 2023).[56] This certainly put pressure on Humboldt's project schedule, who would soon announce the plan for an opus magnum on the geography of plants. In the meantime, he probably profited from Caldas' indebt geographical and botanical knowledge of Andean Nueva Granada. Simultaneously, Humboldt inspired Caldas with his globally comparative scheme of investigation, as the latter's *"Memoria sobre el plan de un viaje proyectado de Quito a la América septentrional,"* written several months after their first encounter, suggests: In this memorandum, Caldas proposed to divide the earth's vegetation into twelve altitudinal zones (Caldas 1966: 312). Humboldt's comparative approach had certainly stimulated Caldas' idea for a global zonation of plants, even if it was, as Caldas stressed, original in its conceptual design.

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53 SBB-PK, Nachl. Alexander von Humboldt (Tagebücher), VIIbb/c, fol. 201r (http://resolver.staatsbibliothek-berlin.de/SBB000152B400000293), 201v (http://resolver.staatsbibliothek-berlin.de/SBB000152B400000294).

54 Ibid. VIIbb/c, fol. 202v (http://resolver.staatsbibliothek-berlin.de/SBB000152B400000296). Cf. Humboldt 2003: 162.

55 For an exchange between Humboldt and Caldas on various methods of measuring altitude, cf. Arboleda 2020.

56 Cf. the contribution "A pioneering critic of Alexander von Humboldt's inventions: Franciso José de Caldas" (http://dx.doi.org/10.18443/372) by Alberto Gómez Gutiérrez in this issue.

This leads to the much-discussed question of the contribution of both researchers to the establishment of the cartographic representation of plant-geographical elevation profiles, which is difficult to resolve completely, since only Humboldt's first sketch of the *"Tableau Physique"* is datable (to February 1803, see below). From an epistemological point of view, it would perhaps be fruitful to move beyond a historiographically "old-school" discussion of scientific priority: a detailed *comparison* of the early plant-geographical images and writings of both naturalists could sensitize us to the idiosyncrasies of their plant-geographical approaches regarding objectives, methods, and scale. At first glance, their sketches look very similar, but a closer observation reveals significant differences. Caldas' profiles stay roughly in the large- to medium-scale of mountains and regions, similar to Humboldt's profile of the path from Cartagena to Bogotá. The *"Tableau physique"* is a small-scale 'infographic' of South America in which the elevation of the Andes is exaggerated to the extreme (Fig. 6). This creates an image area in which geobotanical information can be inserted in the cross section of the Andes and which allows for the display of additional geophysical and biological data on the left and right of the *Tableau*. Whereas Humboldt's chart presents a cross section of the Andes in a west-eastern direction, Caldas mountain profiles follow largely a north-south or south-north direction. In 1803 the Neo-Granadian naturalist started with simple two-dimensional profiles, emulating Humboldt's early attempts at unadorned mountain profiles; his later, brillantly illuminated drawings pay particular attention to the spatial depth of landscapes while establishing a unique color-coding system for the depicted vegetational zones (Fig. 7).

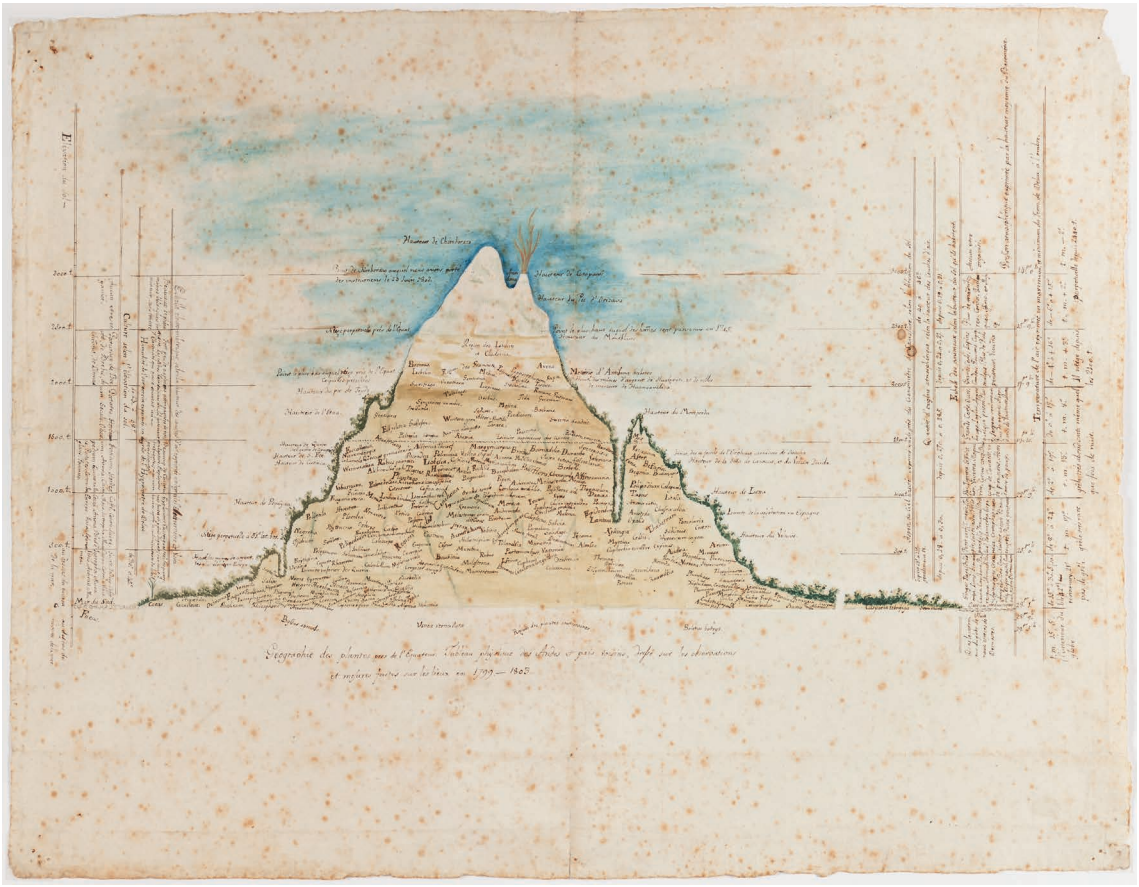

Fig. 6: Alexander von Humboldt: "Géographie des plantes près de l'équateur. Tableau physique des Andes et pa[y]s voisins, dressé sur les observations et mesures faites sur les lieux en 1799–1803" (1803). Museo Nacional de Colombia, Bogotá, reg. 1204.

In February 1803, Humboldt transmitted the *Prospectus* regarding a forthcoming work on plant geography as well as a chart, entitled *"Géographie des plantes près de l'Équateur. Tableau physique des Andes et pais [sic] voisins, dressé sur les observations et mesures faites sur les lieux en 1799–1803"* (Fig. 6) with a description of the sketch to Juan Pío de Montúfar y Larrea, who subsequently forwarded it to Caldas. Finally, Caldas transmitted the documents to the intended recipient of the manuscript, José Celestino Mutis.

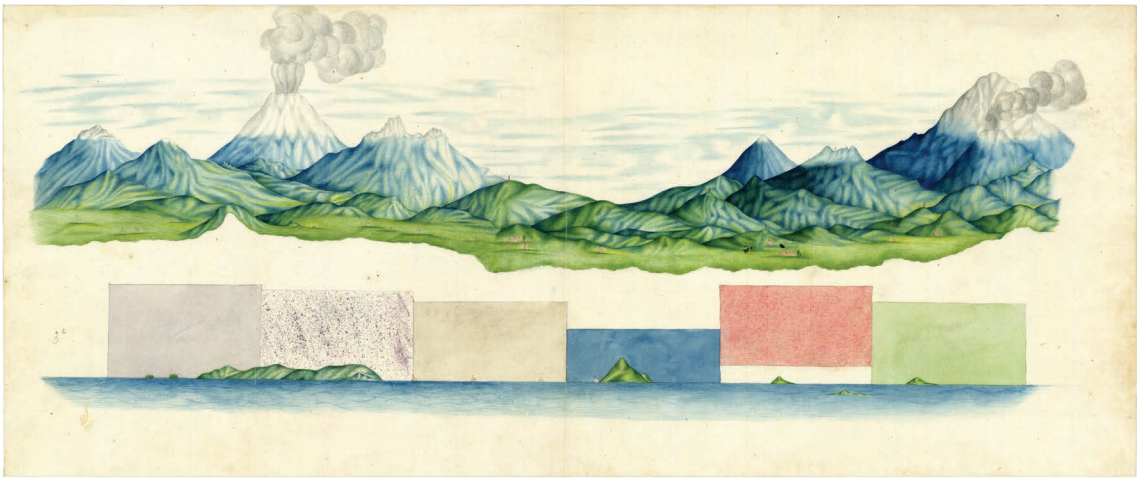

Fig. 7: Francisco José de Caldas: "Perfil de los Andes de Loja a Quito", serie 2, Lámina 4. Mauricio Nieto Olarte: La Obra cartográfico de Francisco José de Caldas. Bogotá: Uni-andes-ACCEFYN-ACH-ICANH, 2006, pp. 142–143.

Humboldt's conceptual work on the plant-geographical works, *Essai sur la Géographie des Plantes, accompagné d'un tableau physique des régions équinoxiales* (1805, published in 1807), or *Ideen zu einer Geographie der Pflanzen nebst einem Naturgemälde der Tropenländer* in its German version (1807), was thus completed. It is important to note that the period between Humboldt's arrival in Bogotá and his departure from Quito proved pivotal in the development of his subsequent project on the physics of the earth. In his subsequent works, Humboldt expanded the combination of profile representations with vegetation levels, which he had first attempted in this period, into large comparative models in which he employed snow and vegetation boundaries as analytical connecting links in a globally conceived plant geography.[57]

Conclusion

Humboldt kept a copy of the *Prospectus* sent to Mutis as well as one of the drawing. This written and visual condensation of three years of observations became the reference point for plant-geographical notes during the following leg of the journey, which took Humboldt and Bonpland through Mexico, or more precisely the Viceroyalty of New Spain (March 22, 1803–March 7, 1804). From 1803 onwards, we find remarks in the journal such as "Voyez le Prospectus que j'ai fait

57 Cf. for example Humboldt/Bonpland/Kunth 1815–1825, I: iii–lviii ("De instituto operis et de distributione geographica plantarum secundum coeli temperiem et altitudinem montium prolegomena") and the frontispiece of the first volume: "Geographiae plantarum lineamenta".

pour la Planche" or "Voyez le Prospectus de ma Géographie des Plantes."[58] In his "Testament littéraire" written in 1804, which contains a concrete six part plan for the publication of his travels, Humboldt defines the *Prospectus* as the conceptual guide for the design of an "Atlas géologique, botanique et physique." As the first section of the work, the atlas was to contain profile maps of the journey, including the "Tableau physique des Andes."[59] This corresponds to Humboldt's announcement of a "Geografía de las plantas accompañada de mapas" in a short article entitled "Geografica fisica. Ideas sobre el límite inferior de la nieve perpetua, y sobre la geografica de las plantas" published in Havana in May 1804, at the end of the American voyage (Humboldt 1804). In the first draft of the *"Tableau physique"* and the accompanying description in 1803, Humboldt had already indicated the mountain heights of other regions of the world as a means of comparison and contrasted the vegetation forms of the temperate and tropical zones (Humboldt 1803/1809: 129; 150). Humboldt's eleven-month stay in New Spain in 1803 and 1804 gave him the opportunity to directly compare the geographical and climatological conditions of North and Equatorial America. As he had previously done in the Andes, he now examined the snow and vegetation boundaries of New Spain's mountains and compared them with the earlier data.[60] The plant geography program designed in the years 1799 to 1803 now finally became part of a globally interconnected scientific endeavour. In 1807, two years after his return to Europe, Humboldt placed his findings in a global context with the help of data collected by naturalists from Europe as well as South and North America in a chart whose commentary significantly expanded compared to the 1803 manuscript. The goal was not only to embrace all physical phenomena of the earth and the atmosphere that could be measured, but also to advertise the findings that would be published in the upcoming volume covering his travels (Humboldt 1807a: V–VI).

At various stages of his journey Alexander von Humboldt developed the plant geographical project he had outlined in 1794. The years spent in the tropical regions of the Americas led to a revision and a new focus of the research program established in Europe. Questions about global plant migrations and the interrelationship of the history of plants and mankind were relegated to a position of lesser importance, as they could not be answered with the means of field research. Conversely, the idea of an alliance between natural science and the arts emerged as a new focus of the project, manifesting in the study of vegetation physiognomy. The experience of traversing the Andes and the encounter with Neo-Granadian naturalists had a significant impact on the early visual and written consolidation of the plant geography research results of the journey, as evidenced by his output in 1803.

Humboldt's plant geographical project did not end with the publication of the *Essai* and the *Tableau* in 1807. In fact, it proved to be a "life project" in both senses of the word. Having left botanical fieldwork behind, Humboldt explored new statistical and graphical methods at his Parisian desk. The goal was to capture an ever-growing number of newly discovered plants and determine global distribution patterns through the method of botanical artithmetic (Knobloch 2009). However, the plan for a completely reconceptualized second edition of the *Essai,* which was now to cover not only tropical America but the entire world, failed. The accumulation

58 SBB-PK, Nachl. Alexander von Humboldt (Tagebücher), VIII, fol. 52v (http://resolver.staatsbibliothek-berlin.de/SBB0001527B00000068); IX, fol. 28v (http://resolver.staatsbibliothek-berlin.de/SBB0001527C00000044).

59 Ibid. VIII, fol. 167v (http://resolver.staatsbibliothek-berlin.de/SBB0001527B00000347).

60 Cf., for example, ibid., VIII, fol. 52v (http://resolver.staatsbibliothek-berlin.de/SBB0001527B00000068).

of an increasingly unwieldy body of botanical data contributed to this outcome. Yet a more fundamental issue may have been the methodological inconsistencies inherent to Humboldt's science of plant geography: As a field of research encompassing both man and nature, empirism and aesthetics, and serving as the foundational discipline for Humboldt's climatology and cosmology, it was subject to heuristic overload.

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