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If Humboldt had a Laptop. Moving Knowledge Networks from Print to Digital Media

ABSTRACT

The difficult publication history and expensive editions of Alexander von Humboldt's volumes on the expedition to the Americas have resulted in incomplete library holdings which has limited scholarly access and sometimes caused unbalanced scholarship. A plan for a Humboldt Digital Library examines the structures and features of this representational system in print and proposes models for converting these materials to electronic form. Several issues posed by Humboldt's works include: establishing authoritative standard editions in several languages, creating high-resolution access to the many visual innovations in the works, and using software to restore the grand concept that all of the separate disciplines of study can be seen as interrelated parts of the whole. Using techniques of geographic visualization, a prototype is planned which will connect this historical body of knowledge with modern scientific databases.

ZUSAMMENFASSUNG

Durch die verwickelte Publikationsgeschichte und aufwendige Ausgaben von Alexander von Humboldts amerikanischem Reisewerk ist dieses in den Bibliotheken oft nur lückenhaft vorhanden, was den Zugang erschwert und daher manchmal auch unausgewogene Forschungsergebnisse zur Folge hatte. Der folgende Entwurf für eine digitale Bibliothek von Humboldts Reisewerk untersucht die Strukturen und Eigenschaften dieses Darstellungssystems in Druckform und empfiehlt Modelle, wie das Material in elektronische Form umgesetzt werden kann. Unterschiedliche Aspekte von Humboldts Werk stellen dabei folgende Herausforderungen: die Herstellung zuverlässiger Standardausgaben in mehreren Sprachen, die Entwicklung von Zugriffsmöglichkeiten mit hoher Auflösung für die vielen visuellen Innovationen im Reisewerk, und die Anwendung einer geeigneten Software, um den großartigen Entwurf herzustellen, wobei bisher getrennte Wissenschaftszweige als zusammenhängende Bestandteile des Ganzen gesehen werden können. Mit der Technik geographischer Visualisierung wird ein Prototyp konzipiert, mit dem diese historische Sammlung von Erkenntnissen mit modernen naturwissenschaftlichen Datenbanken verbunden wird.

Alexander von Humboldt's travel diary of his journey on the Orinoco in April 1800 reminds us of the complex and difficult stages of his writing process. First, the preparation to writing often included observations through procedures and instruments. Then, creating opportunities for the physical act of writing was a challenge for this expedition on the move, especially when the standards involved "orderly and detailed" entries. Finally, there were some very particular torments of nature:

> Die unbegreifliche Qual, welche wir täglich von dem Stechen des Ungeziefers seit Carichana leiden, macht es schlechterdings unmöglich, ein ordentliches und ausführliches Tagebuch zu halten. Das meiste muß dem Gedächtnis anvertraut werden, und ich werde daher nur aphoristisch die Materialien niederschreiben.[1]

> Welch eine Lage, wenn man die wenige Reisemuße benutzen soll, um eine Pflanze zu beschreiben, eine Blume mit Nadel und Microscop zu zergliedern, Horizont zu nivellieren […] Man glaubt, alle Sekunden alle Instrumente, Blumentheile verzweiflungsvoll fallen zu lassen, wenn alle Hände voll stechender [In]Sekten sind und man keine dritte Hand hat, sich ihrer zu wehren.[2]

The unbelievable torture, which we suffer daily from the bites of vermin since leaving Carichana, makes it virtually impossible to keep an orderly and detailed journal. Most of it has to be entrusted to memory, and I will therefore only aphoristically make notations on the materials.

What a situation, when one has to use the infrequent rests from traveling in order to describe a plant, disect a flower with needle and microscope, sight the horizon … you think at any second you will have to drop in desperation all the instruments, flower parts, as both hands are covered with biting insects and you have no third hand to defend yourself from them.

But while clouds of mosquitoes may have momentarily hindered putting pen to paper, in the end it was the decades-long struggle with collaborators, publishers, and his own research ambitions with an ever-expanding, closure-resisting process of writing which left Humboldt's account of the travel expedition in the Americas a difficult and fragmented legacy.

Thirty years later in a letter from April 1830, Humboldt took stock of his efforts in this often-cited passage:

> Leider, leider! meine Bücher stiften nicht den Nutzen, der mir vorgeschwebt hat, als ich an ihre Bearbeitung und Herausgabe ging; sie sind zu theuer! Außer dem einzigen Exemplar, welches ich zu meinem Handgebrauch besitze, gibt es in Berlin nur noch zwei Exemplare von meinem amerikanischen Reisewerk. Eins davon ist in der königlichen Bibliothek und vollständig, das zweite hat der König in seiner Privatbibliothek, aber unvollständig, weil auch dem König die Fortsetzungen zu hoch gekommen sind.[3]

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1   Alexander von Humboldt, *Reise durch Venezuela. Auswahl aus den amerikanischen Reisetagebüchern,* ed. Margot Faak (Berlin: Akademie Verlag, 2000) 259.

2   Humboldt, *Reise durch Venezuela* 261.

3   Alexander von Humboldt, *Briefwechsel Alexander von Humboldt's mit Heinrich Berghaus aus den Jahren 1825 bis 1858* (Leipzig: Costenoble, 1863) quoted in *Gespräche Alexander von Humboldts,* ed. Hanno Beck (Berlin: Akademie Verlag, 1959) 121.

Alas, alas! my books have not yielded the benefits that I imagined, when I set about editing and publishing them; they are too expensive! Besides the one copy, which I own for my personal use, there are only two copies in Berlin of my American travel volumes. One of them is in the Royal Library and is complete, the second the king has in his private library, but it is incomplete, because even for the king, the installments became too expensive.

The factors Humboldt mentions here—expensive volumes and incomplete sets in a very limited number of libraries—have not been solved in the nearly two hundred years since his travels. Now a new effort has been organized to create an Alexander von Humboldt Digital Library to make these works available to a larger audience.[4] The project focuses on digitizing the multi-volume account of the travels of Alexander von Humboldt and Aimé Bonpland in the Americas from 1799 to 1804 known as *Voyage aux régions équinoxiales de Humboldt et Bonpland.*

One reason for the Humboldt Digital Library is to simply have access to the volumes which are not readily available in print. But a fully realized electronic version might also restore the grand concept behind Humboldt's publishing efforts—that all of the separate disciplines of study which received specialized treatment in the various volumes can only fully be understood when related and interrelated to all of the parts of the whole. It is an ironic contradiction of history that Humboldt's spirit of comprehensive scope, of interconnectedness, of quick and insightful comparisons that made him such a popular figure in the salon culture of Paris and Berlin, has so far been embodied in a corpus of abbreviated texts, small and poor reprints, or incomplete sets of his original volumes in widely-separated rare book rooms.

Humboldt's publishing quest was of course the ever recurring dream of having a system of information storage and representation that can adequately reflect the complexity of a large domain of knowledge. This is the struggle of Diderot's *Encyclopedie* which led to the system of embedded references from one article to another—early hypertext links—but also a game of hide and seek with the censors. This was also Humboldt's thirty-year struggle to assemble teams of scientists and artists to portray in print and visuals a comprehensive view of his explorations.

The media and storage mechanisms for realizing systems to enhance knowledge retrieval were long based on books, encyclopedias, and libraries. While chess-playing automatons treated eighteenth-century audiences to the subterfuge of a machine capable of thinking, it was not until 1945 that some of the first practical proposals resulted in a shift to automated mechanical augmentation of knowledge retrieval. Vannevar Bush's "As We May Think" emphasized associative processes of the mind and the need for more flexible tools than rigid indexes and slow

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4   The organizing team includes participants from the University of Kansas Max Kade Center (Frank Baron and Rex Clark), the Natural History Museum and Biodiversity Center (John Simmons), and the Kansas Geological Survey. From Germany it includes the Alexander von Humboldt Research Center of the Berlin-Brandenburg Academy of Sciences (Ulrike Leitner), the Research Center on Travel Literature at the Landesbibliothek in Eutin (Wolfgang Griep), and the University of Applied Sciences Offenburg (Detlev Doherr). The University of Chicago ARTFL electronic text project (Mark Olsen) has provided cooperation and support. A grant submitted by Ulrike Leitner and Frank Baron has received funding from the TransCoop-Programm of The Alexander von Humboldt Foundation. This will support development of the project and two conferences.

library retrieval.[5] As President Roosevelt's Science Advisor, he saw an opportunity for the scientists assembled during the war to shift their attention to large-scale peaceful pursuits. Bush conceived of a machine using microfilm that could link together and retrieve information to augment mental processes. During the 1960s the computer became the ideal machine for what was labeled "hypertext" by Theodor H. Nelson in his techno-utopian vision of writers and readers.[6] By the 1980s scholars had begun to explore connections between literary traditions, cultural theory, and the new media of computer systems.[7] In 1992 George P. Landow's experience with the "Intermedia" software designed at Brown University led him to claim that computers had begun to instantiate the literary theories of Roland Barthes and others.[8] With the growth of the internet and the many forms of new electronic media, computer-based knowledge systems have become the norm and cultural theories on the topic seem inexhaustible.

If, on the one hand, the theory and metaphor of modern critical thought has been seen to converge with the concept of the computer network, on the other hand, the work of Ottmar Ette has also presented the remarkable affinities between Humboldt's writing and textual strategies and the theories of modernism by Jürgen Habermas, Roland Barthes and others.[9] It is interesting to speculate how certain historic personalities or a certain corpus of writing might be ideally suited to utilize the advantages of a medium such as a networked digital library. How would our understanding of Humboldt change with a networked technology supporting multiple readings of connectedness between the scattered parts of the *Voyage de Humboldt et Bonpland*? Collecting the materials into a unified system no longer presents the challenges of feasibility which confronted Humboldt when working with the print media and publishing industry. The amount of material is moderate by today's standards. But the challenge remains to create a design for reading, viewing, and connecting Humboldt's works in a meaningful way using the publishing paradigm of the network.

The complexity of this work and the related textual and historical issues of translation and reception require some initial thought on how to conceptualize the Humboldt Digital Library. There are at least four problem areas, both practical and theoretical, presented to Humboldt

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5   Vannevar Bush, "As We May Think," *Atlantic Monthly* 176 (1945): 101–8. See also James M. Nyce and Paul D. Kahn, eds., *Vannevar Bush and the Mind's Machine: From Memex to Hypertext* (San Diego: Academic Press, 1991).

6   Theodor H. Nelson, *Computer Lib/Dream Machines* (Seattle: Microsoft Press, 1987); Nelson, *Literary Machines* (Swarthmore, Pa.: Self-published, 1981).

7   Walter J. Ong, *Orality and Literacy: The Technologizing of the Word* (London: Methuen, 1982); Jay David Bolter, *Writing Space: The Computer in the History of Literacy* (Hillsdale, N.J.: Lawrence Erlbaum, 1990).

8   "Hypertext blurs the boundaries between reader and writer and therefore instantiates another quality of Barthes's ideal text. From the vantage point of the current changes in information technology, Barthes's distinction between readerly and writerly texts appears to be essentially a distinction between text based on print technology and electronic hypertext […]" George P. Landow, *Hypertext: The Convergence of Contemporary Critical Theory and Technology* (Baltimore: Johns Hopkins University Press, 1992) 5.

9   Ottmar Ette, "Alexander von Humboldt und das Projekt der Moderne," Ottmar Ette and Walther L. Bernecker, eds., *Ansichten Amerikas. Neuere Studien zu Alexander von Humboldt* (Frankfurt am Main: Vervuert, 2001) 9–17; Ottmar Ette, *Literatur in Bewegung. Raum und Dynamik grenzüberschreitenden Schreibens in Europa und Amerika* (Weilerswist: Velbrück, 2001).

scholarship. In each case these issues can be matched with a model or a concept for designing a digital library. These four areas are:

- establishing and providing access to a standard version of Humboldt's *Voyage*
- creating appropriate access to appreciate Humboldt's visual innovations
- addressing issues of a multi-lingual, searchable text corpus including historical translations and related questions of national reception processes
- updating Humboldt's system of representing knowledge in a new medium and the possibilities of using these works as a data-driven hypertext with links to modern scientific databases

The remainder of this essay examines each of these areas, outlining each set of problems and proposed solutions.

Problem #1: Lack of access and cataloging uniformity

One of the more difficult aspects of working with Humboldt is simply gaining access to his works. The barriers cover the range of archive access issues, including a history of bibliographic confusion, the inherent restrictions of costly and rare editions, and the lack of complete and reliable reprints.

The long and difficult publication history and the often haphazard manner of binding the sections as they were delivered from the publisher have made the library holdings and cataloging very irregular. The introduction to the bibliography of Fiedler and Leitner, published in 2000, discusses the tangled history of confusion and neglect of Humboldt's works.[10] With this authoritative work we now have a reliable reference to the original works, variant editions, and translations.[11] Following this research, we can now speak of 29 original volumes using a standard title of *Voyage aux régions équinoxiales de Humboldt et Bonpland* which appeared both in complete volumes and in numerous partially published sections (fascicles) from 1805–1838.[12]

The 19 folio and 10 quarto volumes of the *Voyage de Humboldt et Bonpland* are organized into six sections according to general disciplines. Since the individual works within these sections have separate titles which are often used without reference to their inclusion within a larger

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10   "Unter den hervorragenden Persönlichkeiten der deutschen Kultur- und Wissenschaftsgeschichte dürfte es keine zweite geben, deren Werk so umfangreich, so vielfältig und dabei so schwer überschaubar und bibliographisch so unerschlossen ist wie dasjenige Alexander von Humboldts. [...] So wird beispielsweise aus dem vielbändigen Werk über die Amerikareise seit jeher zitiert, übersetzt und kompiliert, Einigkeit aber besteht nicht einmal über dessen Namen, den Gesamttitel, die Gliederung des Ganzen oder über die Zugehörigkeit bestimmter Schriften zu dem monumentalen Unternehmen. Einem bibliographischen Irrgarten gleich, widersprechen einander ferner Aussagen über Erscheinungsjahre, Verlegernamen, Seitenumfänge oder Illustrationsbeigaben zu ein und denselben Drucken. Derselbe Text kann außerdem unter ganz verschiedenen Titeln auftauchen." Horst Fiedler and Ulrike Leitner, *Alexander von Humboldts Schriften. Bibliographie der selbständig erschienenen Werke* (Berlin: Akademie Verlag, 2000) xvi.

11   I will make use of the numbering system of the Fiedler/Leitner *Bibliographie* by using a reference such as "F/L Nr. 4.1" which refers to a specific title and edition, in this case the quarto edition of the *Relation historique.*

12   Fiedler/Leitner 67–69.

work, it will be useful to quickly summarize the topical divisions and some of the more well-known short titles.

> *Partie 1* has six volumes devoted to the travel narrative and related visual and map materials. It contains the well-known three-volume travel narrative, the *Relation historique,* along with the illustrated *Vues des Cordillères,* and the map folio *Atlas géographique et physique des régions équinoxiales du Nouveau Continent* which contains a lengthy history of geographical works on the new continent known as *Examen critique.*

> *Partie 2* consists of the two-volume work on zoologie, *Recueil d'observations de zoologie.*

> *Partie 3* has three volumes including a folio atlas and a two-volume treatise on the political economy of what is now Mexico, *Essai politique sur la royaume de la Nouvelle-Espagne.*

> *Partie* 4 is a two-volume compilation of the geographic and elevation measurements taken during the expedition, *Recueil d'observations astronomiques.*

> *Partie 5* is one of the founding documents of the study of plant distribution, *Essai sur la Géographie des plantes.*

> *Partie 6* contains 15 illustrated volumes with Latin text entries for the scientific description and classification of the botanical collections from the expedition. The *Nova Genera et Species Plantarum* volumes have become a standard work of botanical reference.

The bibliographic confusion is only one reason that the *Voyage* volumes have never been accessible to a wide audience. The small press runs and high price of some of the luxurious volumes made them a rarity in Humboldt's day. Their erratic publication made it difficult to compile a full set. Consequently only a few libraries world-wide have a complete set of the 29 volumes and the price for acquiring some of the missing volumes on the rare book market is beyond the reach of most libraries.[13]

With the Fiedler/Leitner bibliography, we now we have a reliable guide for a visit to the rare book room, but what reproductions or reprints are available as substitute editions outside the major libraries? While a complete reprint was done in the 1970s, this opulent set appeared in a very limited edition of 200 copies, so the reprint is almost as rare as the original.[14] There are two editions on microfilm. The OmniSys Collection published six reels and these are currently available from Norman Ross Publishing.[15] There was also microfiche edition from IDC from

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13   For example, a copy of the folio edition of the *Vues des Cordilléres* has been offered for US$ 96,000 by Bernard J Shapero Rare Books, London, 17 Dec. 1999 http://www.shapero.com/. A copy priced at US$ 39,000 was offered by Donald A. Heald Rare Books of New York, 17 Oct. 2000 http://abaa.org/findbookseller/bookseller.cgi?firmid=206.

14   *Voyage de Humboldt et Bonpland,* facsimile reprint, 30 vols. (Amsterdam: Theatrum Orbis Terrarum; New York: Da Capo Press, 1970–73).

15   *Voyage de Humboldt et Bonpland,* 35mm microfilm, 6 reels, catalog cards. The OmniSys Collection is currently published by Norman Ross Publishing. It was formerly published by OmniSys Inc., and originally published by General Microfilms, June 15 2001 http://www.nross.com/omnisys/history.html.

1966, but it is not clear whether this is currently available.[16] While these editions are a good resource, there are numerous problems. The microfilm technology does not provide quality reproduction of color plates and large-scale maps. The difficulties of bibliography and editions are reproduced here as well—there are missing volumes and even incomplete books. For example the Library of Congress copy of the third volume of the *Relation historique* in the OmniSys Collection was apparently bound before the last fascicle arrived and thus has only 501 instead of the full 629 pages.

Model #1: Electronic page images for low-cost access with bibliographic accuracy

The first reason for a digital edition of Humboldt is thus to fill the real need for a bibliographically reliable standard edition that is widely available. The first implementation stage is simply to photograph or scan every page of the volumes, combine this with the authoritative information from the Fiedler/Leitner bibliography, and make this available on a CD-ROM as well as on the web. Like microfilm, the text would not be searchable or electronically indexed, there are only digital pictures of the pages. There are many examples of digital libraries which provide access to materials with this method. In fact, the Bibliothèque national de France has a large project to put digital images of significant works on the web called "Gallica, la bibliothèque numérique." Both of the microfilm editions of Humboldt are now available as non-searchable PDF and TIFF page image formats at the Gallica web site.[17] If a carefully corrected, revised, and completed version of electronic page image files along the lines of the Gallica project were produced, this would provide a valuable reference edition of the French originals.

Problem #2: Presenting the visual

The second reason for a Humboldt digital library has less to do with a desire for bibliographic order and appeals more to an appreciation of the visual. Humboldt was a pioneer of modern visual representation.[18] His works include large foldout maps, statistical tables and graphs, and above all lavish color illustrations of plant and animal life. Just as these features are

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16   *Voyage de Humboldt et Bonpland,* 193 microfiches, 8 x 13 cm, 1966. Currently the company is IDC Publishers in the Netherlands, June 15 2001 http://www.idc.nl.

17   The *Voyage* volumes are mostly listed with individual volume titles and include microfilm credits of either "Numérisation BnF de l'édition de Cambridge (Mass.): Omnisys, [ca 1990] (Latin American travels)" or "Numérisation BnF de l'édition de Leiden: IDC, [19--?]" June 15 2001 http://gallica.bnf. fr/. Advanced search functions are available for the "Catalogue des documents numérisés": June 15 2001 http://catalognum2.bnf.fr/html/i-frames.htm.

18   The following evaluations of Humboldt's visual innovations in cartography and the history of science provide an introduction to the large interest in this topic: Susan Faye Cannon, *Science in Culture: The Early Victorian Period* (New York: Dawson, 1978); Hanno Beck, "Alexander von Humboldt's Contribution to Cartography," *Alexander von Humboldt: Life and Work,* ed. Wolfgang-Hagen Hein (Ingelheim am Rhein: C.H. Boehringer Sohn, 1987; German edition, 1985) 239–48; Lothar Zögner, "Carl Ritter und Alexander von Humboldt—ihr Beitrag zur Entwicklung der thematischen Kartographie," *Studia Geographica. Festschrift für Wilhelm Lauer zum 60. Geburtstag* (Bonn, 1983) 393–406; Anne Marie Claire Godlewska, "From Enlightenment Vision to Modern Science? Humboldt's Visual Thinking," *Geography and Enlightenment,* ed. David N. Livingstone and Charles W. J. Withers (Chicago: University of Chicago Press, 1999) 236–75; Godlewska, *Geography Unbound. French Geo-*

important for a full understanding of Humboldt, they have made reproductions difficult and expensive. The combination of very high resolution electronic copies together with software to zoom and enlarge for inspection of details would allow for an extraordinary display of visual-ly-striking historical and scientific documents.

The original edition of *Vues des Cordillères* (F/L Nr. 4.3) was an expensive large folio format (40 × 55 cm) containing 69 plates with over 350 pages of commentary. A small format version of the work with only 19 plates was published almost immediately in French and shortly after-wards in English. Even at the time the shortcomings of these smaller editions were criticized. In 1816 the *Quarterly Review* noted that: "we have now in the 'Researches,' references to plates that have no existence, or exist only in another book. This, we repeat, is bad management [...]"[19] The illustrations were some of the first accurate reproductions of the natural features of the Americas, including scenes from the high Andes, waterfalls, and volcanic landscapes. The illus-trations introduced European audiences to many aspects of the architecture, sculpture, man-uscripts, and calendar systems of pre-Columbian culture. These images played a large role in redefining the concept of the natural and cultural history of the Americas.[20] Despite the fact that these illustrations are the most often reproduced and show up in almost every work by or about Humboldt, the poor quality of these reproductions means that wide access to their details can only be solved with an electronic edition.[21]

The accompanying atlas to Humboldt's *Relation historique* which included his travels within the Orinoco basin and northern South America, *Atlas géographique et physique du Nouveau Continent* (F/L Nr. 4.4), is quite rare and has not been reproduced or otherwise made avail-able.[22] Of particular interest is Plate 16 which is a detailed map of the communication between the Orinoco and Amazon watershed areas via the Casiquiare river which was made famous by Humboldt's expedition. Embedded in the map are text notes on the route and encampments as well as indications of indigenous population areas and other localized historical information.

graphic Science from Cassini to Humboldt (Chicago: University of Chicago Press, 1999); Michael Dettelbach, "Global Physics and Aesthetic Empire: Humboldt's Physical Portrait of the Tropics," *Visions of Empire. Voyages, Botany, and Representations of Nature,* ed. David Phillip Miller and Peter Hanns Reill (Cambridge: Cambridge University Press, 1996) 258–92.

19 "Humboldt's *American Researches,*" *Quarterly Review* 15 (1816): 441.

20 Interest in Humboldt's illustrations in the fields of art history, pre-Columbian and modern South American history are represented by: Renate Löschner, "The Influence of Alexander von Humboldt on Illustratiolns of America," Hein, 283–300; Eloise Quiñones Keber "Humboldt and Aztec Art," *Colonial Latin American Review,* 5.2 (1996) 277–97; Keber, *Codex Telleriano-Remensis: Ritual, Divi-nation, and History in a Pictorial Aztec Manuscript* (Austin: University of Texas Press, 1995); Miguel Rojas-Mix, "Die Bedeutung Alexander von Humboldts für die künstlerische Darstellung Lateiname-rikas," *Alexander von Humboldt, Werk und Weltgeltung,* ed. Heinrich Pfeiffer (München: Piper, 1969).

21 Two modern editions of this work have introductory essays and contain excellent but greatly reduced reproductions of the plates: a facsimile reproduction (F/L Nr. 4.3.2.4) ed. Charles Minguet (Nanterre, France: Éditions Erasme, 1989) and a Spanish translation from 1974 has been reissued with extensive introduction and textual notes (F/L Nr. 4.3.5.3) *Alexander von Humboldt. Vistas de las Cordilleras y monumentos de los pueblos indígenas de América,* ed. Jaime Labastida (México, D. F.: Siglo XXI Editores, Smurfit Cartón y Papel, 1995).

22 Humboldt's other major atlas work, the so-called *Mexico-Atlas* or *Atlas géographique et physique du royaume de la Nouvelle-Espagne* (F/L Nr. 4.6.10), has been reproduced in a large format print edition (F/L Nr. 4.6.10.2), ed. Hanno Beck and Wilhelm Bonacker (Stuttgart: Brockhaus, 1969).

Because of its size (48 × 64 cm), most reproductions of this and other plates are so reduced as to be illegible.[23] Therefore one of the more important visual representations of contact between the European Enlightenment and the cultural spaces of the Americas is seriously compromised.

Two zoological volumes, *Recueil d'observations de zoologie* (F/L Nr. 4.5), were published in at least a dozen separately delivered sections over a period of 28 years. As a result, copies of this work are very often incomplete and are often bound in odd combinations of text sections and plates. These volumes have essentially never been reprinted and there is only an incomplete German translation. While the beautifully colored engravings of animals, birds, fish, mussels, butterflies and other insects are often seen reproduced in the Humboldt literature, the originals are probably very rarely consulted within the context of the interpretive texts.

Further examples of the visual legacy which could benefit from electronic access are the illustrations on plant geography and botany. This includes above all the landmark Humboldt visualization of plant distribution zones, the "Tableau physique" which accompanied the *Essai sur la géographie des plantes* (F/L Nr. 4.8). This large plate (89 × 58 cm) shows how altitude elevation and the resulting climate zones determine the distribution of plants much as the change in climate from south to north. Almost universally cited as a central document in establishing the field of plant geography, it is often seen as an important representation of early ecological thought. The concept of the plate relies above all on a detailed combination of visual, textual, and scaled measurement information. Although it has been reproduced countless times, it is shown in such a reduced format that it is doubtful that most viewers have ever had a chance to find and relate to a single example of a plant species located at a particular elevation among the hundreds of examples in the text legends. It would be a trivial computer task to transcribe and link the texts and plant names to appropriate glossaries and databases.

The largest collection of visual material is of course the 700 large folio color botanical engravings of the *Nova Genera* (F/L Nr. 6.3) along with the several hundred engravings in the other botanical works. This is the record of the expedition's extensive collection of botanical samples which remarkably added about 3,600 new species to the small catalog of only about 8,000 plant species which had been classified at that time.[24] Having this collection available would appeal to a wide audience of scholars and the general public interested in scientific illustrations of plants.

Model #2: High-resolution electronic reproduction of plates, maps, and charts

The total number of plates in the Humboldt *Voyage* volumes is about 1,500. There is no doubt that a project to digitize this relatively small amount of material would bring a great benefit to Humboldt research and to a wide audience from the many disciplines represented by this col-

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23   One legible reproduction at about 75 % scale is now available with the set of maps in the end sleeve of Humboldt, *Reise durch Venezuela.*

24   For these figures and a general overview of the subject see Klaus Dobat, "Alexander von Humboldt as a Botanist," Hein 167–93.

lection. So the second stage of a Humboldt Digital Library is to make high-resolution electronic reproductions of the visual materials.[25]

Problem #3: Access to and reception of Humboldt's works in multiple languages

The story of Humboldt's works in translation is particularly complex and troublesome. In an essay from 1996, Ottmar Ette discusses the history of German translations of Humboldt in terms of "surrogates and extracts." He outlines the sometimes extreme examples of how Humboldt's *Relation historique* has been changed, modified, and ideologically rewritten in a series of transformations with little regard to the almost forgotten original.[26] A similar study could be written on Humboldt in English and the effect of translations, editions, and access upon the process of reception.[27] For example, in the latest English version of the *Relation historique,* the 1995 Penguin Classics paperback edition of the *Personal Narrative* translated by Jason Wilson, the original 2,000 page travel narrative is reduced to only 300 pages, so something certainly was lost in this translation.[28]

To illustrate the shortcomings of the present texts, if one wanted to study Humboldt's summary overview on the area which became modern Venezuela in book 9 or chapters 25 and 26 of the *Relation historique,* most modern translations include only the text of book 9 with 154 pages, and omit or severely abbreviate the much longer "notes" section which has 167 pages.[29] It is often in these page-long footnotes or lengthy endnotes where Humboldt writes some of his most interesting mini-essays on indigenous language structures, provides details of the population of the mission villages along the Orinoco, or includes a large text table of indigenous tribes that he was able to identify from his research on the Orinoco area—all of this never seems to make it into other editions.[30]

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25 An excellent example of the software available for viewing such collections at very high resolution can be seen at the David Rumsey Collection, 15 June 2001 http://davidrumsey.com. Among the many items in this remarkable collection, one Humboldt atlas is available for viewing, the *Mexico-Atlas* (F/L Nr. 4.6.10).

26 Ottmar Ette. "Von Surrogaten und Extrakten: Eine Geschichte der Übersetzungen und Überarbeitungen des amerikanischen Reisewerks Alexander von Humboldts im deutschen Sprachraum," *Deutsche in Lateinamerika—Lateinamerika in Deutschland,* ed. Karl Kohut, Dietrich Briesemeister and Gustav Siebenmann (Frankfurt am Main: Vervuert, 1996) 98–126.

27 A publication history of the English translations has been done by Ulrike Leitner, "Die englischen Übersetzungen Humboldtscher Werke," *Acta historica Leopoldina* 27 (1997): 63–74.

28 Alexander von Humboldt, *Personal Narrative of a Journey to the Equinoctial Regions of the New Continent,* trans. Jason Wilson (London; New York: Penguin Books, 1995).

29 Alexander von Humboldt, *Relation historique du Voyage aux Régions équinoxiales du Nouveau Continent. Fait en 1799, 1800, 1801, 1802, 1803 et 1804 par Al. de Humboldt et A. Bonpland; rédigé par Alexandre de Humboldt.* Neudruck des 1814–1825 in Paris erschienenen vollständigen Originals, besorgt, eingeleitet und um ein Register vermehrt von Hanno Beck, 3 vols. (Stuttgart: Brockhaus, 1970) 3: 1–321.

30 A complete listing of the original pages ommitted in the German translation by Hermann Hauff is given in Fiedler/Leitner 87.

Translations of another major work, the *Vues des Cordillères,* are equally problematic. First to appear was a never-completed German translation which covers only the text for the first 22 plates. This was followed by an English edition which was done with Humboldt's participation. The first Spanish translation did not appear until 1878. A more recent one was done in 1974 with a new edition in 1995.[31] For naturalists, the important zoological volumes have only partially been translated into German and are not available in English or Spanish at all.[32]

If this issue of access in translation is extended to the 29 volumes of the *Voyage,* it is extremely difficult to piece together anything resembling the concept of the whole of Humboldt's major works in any of the languages of translation. Perhaps most difficult is to know what is missing, what has been edited out, and which volumes were perhaps just not translated.

Model #3: Hybrid solution of searchable text and page images

The solution to this is to have all the original texts and the translations input by commercial contractors and to build a searchable text database with this unedited, somewhat unreliable text.[33] When using this system, the reader uses the software to manipulate and search the text. When reliability is needed, the reader brings up the picture of the page of the original edition. Such a hybrid system was developed at the University of Chicago for the ARTFL project's edition of the Diderot and d'Alembert *Encyclopédie* and there is the possibility of using this software platform for Humboldt's works.[34] General tools to create complex text searches are available in such systems. But with a number of specialized indexes created over the years within the Humboldt scholarship, many additional possibilities become available for creating access points into the works.

The focus of such a multilingual digital library is somewhat different from a standard critical edition and may call for the creation of new software tools. Once the originals and the historic translations have been input, the system needs to analyze and show where the missing parts are and provide comparison to the originals. Not only should the software present text in one of the languages of the reader's choice, but the reader of these translations should know when text is missing and be able to refer in such cases to the original or an alternate language version. Flagging missing text and presenting the precise place in an alternative version would be a fairly trivial task for a computer compared with the tedious task of manually lining up and reading through several print versions.

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31   Bibliographic details on these editions are found in Fiedler/Leitner 133–51.

32   Fiedler/Leitner 170–82.

33   There are a number of contractors who provide services primarily to business customers for double-keystroke text input. The two files created by input are compared to reduce errors for better than 99 % accuracy. Presently the cost for these services is about US$ 1 per thousand characters. Thus a rough estimate for text input of the three volumes of *Relation historique* would be approximately US$ 5,000.

34   For information on the ARTFL project at the University of Chicago see: 15 June 2001 http:// humanities.uchicago.edu/ARTFL/.

Problem #4: Accessing the *Voyage de Humboldt et Bonpland* as a scientific database

These first three components for a digital library offer advantages for Humboldt scholarship but have become standard implementation solutions rather than innovations in digital library science. Thus the Humboldt Digital Library project team has worked to conceptualize a more ambitious software implementation with the goal of integrating the historical documents with contemporary scientific databases. The study of biodiversity is one of the modern scientific domains that can meaningfully be connected with Humboldt's works. Studies of biodiversity utilize holistic approaches to examine the relationships among many environmental factors. A main goal of biodiversity research is to track changes to a defined environment over a period of time. Thus Humboldt's historical works, which were based on extensive data collection practices and were conceived and constructed as a interconnected whole, hold the promise of contributing to modern scientific knowledge.

To reconstitute Humboldt's works with modern technology in a meaningful fashion, several problems need to be addressed. The rich interdisciplinary mixture of knowledge domains which is separated into the multiple print volumes needs to be electronically captured so that multiple observations on an particular environmental area can be found and related to each other. This would imply that the three previous stages of the digital library were implemented (page capture, image scans, and text input). Next a method of combining and relating this information is needed. Finally procedures are needed to extract, compare, and update Humboldt's data with information from modern databases. With such a system, multiple connections would be available both between the parts of the corpus and also to documents from the larger scientific community past and present. A set of digital library tools developed for Humboldt's works could easily be a model for utilizing a large number of travel narratives, expedition reports, and works of scientific illustration as historical data sources for modern biodiversity surveys or other scientific projects. Humboldt's works would become an interactive knowledge network that would connect to multiple networks of scientific data available across the internet.

Model #4: Geographic visualization of historic and scientific data

How would such a digital library for historical biodiversity sources be constructed? One possible organizing principle is to structure the texts and graphics around geographic information.[35] Three databases would be created which could be interactively related using common data elements and associated texts. The first database would be constructed with geographic points from Humboldt's maps and itinerary using a geographic information system (GIS) such as the commercial software package ArcInfo. The second database would consist of texts and images from the travel narrative and the descriptions of natural history. These would be indexed so they could be queried with custom search functions for place names and classification names for plant and animal life. With these two sources of information, it would be possible, for example, to locate Humboldt on the banks of the Orinoco with the map software and then bring up examples of insects, plants, birds and other animals that he collected, illustrated, or described

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35 My thanks to Detlev Doherr and Frank Baron for discussions and information from the conference presentation: "Humboldt in Venezuela: Interactive Maps and Archives," Alexander von Humboldt Conference 2001, Humboldt State University, Arcata, California, 18 June 2001.

anywhere in his works. The narrative for this travel time period could be consulted for related remarks on the landscape and environment.

With the historical information in a structured form, queries could be made to a third set of databases on biodiversity. The University of Kansas Natural History Museum and Biodiversity Center has received major funding to consolidate museum records on plant and animal life specimens from museums around the world.[36] With approximately 250 years of collecting activity resulting in museum holdings of an estimated 3 billion specimens, each labeled for the most part with species name, date, and place of collection, this data compilation effort allows for the analysis of shifting biodiversity patterns over time. Interactive queries and the combination of these datasets with the Humboldt materials would inform approaches from both historical and modern standpoints. Readers of Humboldt would have a reference apparatus to look up instances of the flora and fauna and bring up information from the biodiversity database of the regions visited during the expedition. Going in the other direction, modern scientists would have opportunities to reach back into historical documents and use the database links to compare the older picture of biodiversity with current conditions. With further development, the natural history perspective could be related to general historical events, cultural documents, and other selected materials to create a virtual museum—a geographic visualization of the Humboldt expedition.

Humboldt's description of the turtle egg harvest on the Orinoco will serve as an example of the benefits of such a digital library design.[37] As Humboldt's party paddled up the Orinoco in April 1800, they were surprised to come upon an encampment of about 300 people working on collecting turtle eggs. In the *Relation historique,* Humboldt has several pages of description identifying the exact species of the turtle and how they migrate each year to lay their eggs on this particular beach. He further describes how the eggs are harvested and the oil is extracted to be stored in bottles and shipped down the river to be sold in the settlements. In early attempt at a biodiversity species count, Humboldt makes a rough estimate of the turtle population by getting information from the traders on the number of bottles of oil shipped and then calculates the number of turtles needed to produce this amount of oil from the deposit of eggs from just the three harvest beaches. He arrives at a turtle population of at least 330,000 and guesses it might be as high as one million if all of the suitable areas of the lower Orinoco are considered.[38]

The issue of maintaining a sustainable relationship with natural resources and the role of human intervention with the natural world was already a concern for Humboldt and he was

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36   See the following web sites for information on several components of this project: Species Analyst Project, 15 June 2001 http://www.speciesanalyst.net; Specify Project, 15 June 2001 http://usobi.org/specify; Fishnet Project, 15 June 2001 http://habanero.nhm.ukans.edu/fishnet.

37   My thanks to John Simmons for discussions and information from his conference presentation: "Nature Seems More Grand … Humboldt and Bioinformatics," Alexander von Humboldt Conference 2001, Humboldt State University, Arcata, California, 18 June 2001.

38   Humboldt, *Relation historique* 2: 240–50. For examples of Humboldt's descriptions of the turtle populations cited in scientific literature see: Peter C. H. Pritchard and Pedro Trebbau, *The Turtles of Venezuela* (Athens, Ohio: Society for the Study of Amphibians and Reptiles, 1984) 54; Juhani Ojasti, *Wildlife Utilization in Latin America: Current Situation and Prospects for Sustainable Management* (Rome: Food and Agriculture Organization of the United Nations – FAO, 1996) 15 June 2001 http://www.fao.org/docrep/T0750E/t0750e09.htm.

not blind to the power of cultural assumptions. Even on the upper reaches of the Orinoco, Humboldt was very much aware that his view of the relationship between nature and humans was mediated by long periods of cultural history marked by European interventions. In fact the turtle harvest episode can be used to show how Humboldt applies a system of cultural evaluation to compare practices of daily life on the Orinoco from several perspectives. From the recently published manuscript of his travel journal, Humboldt makes this statement at end of his description of the turtle harvest:

> Die Jesuiten ließen immer [eine] Eierschicht übrig zur Erhaltung der Schildkrötenmenge,** jetzt leider! [30v] dies nicht mehr.[39]

> The Jesuits always left a layer of eggs to sustain the population of turtles,** now alas! this is no longer done.

The margin note to the above comment puts it into a much more critical historical context:

> **Vor [der] Conquista [haben] Wilde nie auf jetzigen F[luß] pesca betrieben. Dazu gehört Civilization and Disciplin. [Die] jetzigen Art ist von [den] Jesuiten eingeführt.[40]

> **Before the Conquest, savages never harvested on this river. This requires civilization and discipline. The current way of doing this was introduced by the Jesuits.

Even if this was the shorthand of field notes, these are words which were very much ideologically loaded in Humboldt's day—savages, the conquest, civilization, discipline. Beyond the stark contrast of these categories, the underlying logic of the comparison is clear. The organization of society to make rational use of natural resources is one of the criteria in Humboldt's cultural evaluation schema. Within this ordering, the practices of several historical groups are contrasted.

The published version in the *Relation historique* delineates and differentiates the historical context with more care:

> La récolte des œufs se fait d'une manière uniforme et avec cette régularité qui caractérise toutes les institutions monastiques. Avant l'arrivée des missionnaires sur les bords du fleuve, les indigènes profitoient beaucoup moins d'une production que la nature y a déposée en si grande abondance. Chaque tribu fouilloit la plage à sa manière, et l'on cassoit inutilement une prodigieuse quantité d'œufs, parce qu'on ne creusoit pas avec précaution et que l'on découvroit plus d'œufs qu'on ne pouvoit en emporter. C'étoit comme une mine exploitée par des mains inhabiles. Les pères jésuites ont le mérite d'avoir *régularisé* l'exploitation; et, quoique les religieux de Saint-François, qui ont succédé aux jésuites dans les missions de l'Orénoque, se vantent de suivre l'exemple de leurs prédécesseurs, ils ne font malheureusement pas tout ce qu'exigeroit la prudence. Les jésuites ne permettoient pas qu'on exploitât la plage entière: ils en laissoient une partie intacte, dans la crainte de voir, sinon détruite, du moins considérablement diminuée, la race des tortues *Arrau*.

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39   Humboldt, *Reise durch Venezuela* 257.

40   Humboldt, *Reise durch Venezuela* 257.

The gathering of the eggs is conducted in a uniform manner, and with that regularity, which characterizes all monastic institutions. Before the arrival of the missionaries on the banks of the river, the Indians profited much less from a production, which nature has there deposited in such abundance. Every tribe searched the beach in it's own way; and an immense number of eggs were uselessly broken, because they were not dug with precaution, and more eggs were uncovered than could be carried away. It was like a mine worked by unskilled hands. The Jesuits have the merit of having reduced this operation to regularity; and though the monks of St. Francis, who have succeeded the Jesuits in the missions of the Oroonoko, boast of having followed the example of their predecessors, they unhappily do do effect all that prudence requires. The Jesuits did not suffer the whole beach to be searched; they left a part intact, from the fear of seeing the breed of *arrau* tortoises, if not destroyed, at least considerably diminshed. The whole beach is now dug up without reserve; and accordingly it seems to be perceived that the gathering is less productive from year to year.⁴²

In moving from notes to publication, Humboldt replaces the word "savage" by "the indigenous." The word "conquest" is more specifically defined as the arrival of the monks. "Civilization" is replaced by "regularize" and it means not just making use of the abundance of nature, but fully developing the resources. We see Humboldt, the Prussian mining inspector, applying a mining metaphor to the use of biological resources. And interestingly the shorthand word "discipline" is expanded into a very modern interest in sustainable use of resources. This is played out by drawing on stereotypes of the Franciscans and Jesuits and the history of the Orinoco missions after the expulsion of the Jesuits in 1767.

Humboldt's evaluation of the cultures he encountered is a complex subject. Even in this fairly straightforward description we can see how he carefully works through multiple perspectives and measures them against an evaluative schema. In the recent past, the *arrau* or giant south American turtle *(Podocnemis expansa)* has been listed as an endangered species, and it is now still in need of sustained conservation efforts.⁴³ Humboldt's examination of the cultural attitudes towards natural resources in relation to human activities shows the historical dimensions of a topic which remains under discussion to this day.

Humboldt's writing process, the attempt to capture the travel experience in text, was a difficult and, in the end, abandoned task. The *Relation historique* was never finished and the last three years of the five-year expedition were never formed into a travel narrative. But the project of

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41   Humboldt, *Relation historique* 2: 245.

42   Alexander von Humboldt, *Personal Narrative of Travels to the Equinoctial Regions of the New Continent, during the Years 1799–1804,* trans. Helen Maria Williams (London, 1814–29) 4: 486 (F/L Nr. 4.1.3.1).

43   The International Union for Conservation of Nature and Natural Resources "IUCN Red List of Threatened Species" listed the *Podocdemis expansa* as "Endangered" in 1990 and 1994 and "Lower Risk—conservation dependent" in 1996 and 2000. Information is from: *UNEP-WCMC. Threatened Animals of the World,* 15 June 2001 http://ims.wcmc.org.uk/isdb/Taxonomy/tax-species-result.cfm?Genus=Podocnemis&Species=expansa and C. Hilton-Taylor (compiler), *2000 IUCN Red List of Threatened Species* (Gland Switzerland and Cambridge, UK: IUCN, 2000), 15 June 2001 http://www.redlist.org/search/details.php?species=17822.

the *Voyage* volumes seen as a whole is the much more ambitious attempt at a representational system. Converting these materials to a new electronic medium would provide much needed access and allow for a new understanding of Humboldt's holistic approach. In summary, the goals of this project are to produce highest-quality digital reproductions of the text and illustrations of the *Voyage de Humboldt et Bonpland* in multiple languages, provide searchable access to the text, and then to link these materials with collections in natural history museums using as an organizational principle the method of geographic visualization. Humboldt depleted his considerable personal fortune in his quest to capture his knowledge in print. With a much more modest investment, the Humboldt Digital Library could at long last present this work in a form which will allow it to be examined more fully.[44]

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44   The following are rough estimates for the four implementation levels as described here. For the first stage of making page images, depending on the production quality and amount of new digitizing work required, the cost would run from US$ 10,000–25,000. The second stage of capturing high-quality electronic reproductions of all of the images and illustrations might take from US$ 15–50,000 to accomplish. The third stage to have commerical contractors input the texts could range from US$ 50,000–150,000. A large-scale project to create all of the materials in the first three stages and then combine these with information from geographic and biodiversity databases might cost US$ 250,000 and up.