OBJECTS IN TRANSITION

an exhibition at the Max Planck Institute for the History of Science, Berlin

August 16 – September 2, 2007
Exhibition by
Gianenrico Bernasconi, Anna Maerker, Susanne Pickert

Production
Rainer Kaufmann Ausstellungsproduktion

Display
Design Mark Rosinski

Graphics
Bruno Dorn

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In 2005 the Max Planck International Research Network on the History of Scientific Objects was constituted with the participation of eleven universities, museums, and research institutes in Europe and North America. The aim of this five-year international collaboration is to explore scientific objects: as things, as images, and as concepts. The first activity of the Network was the Wandering Seminar described in the Introduction to this catalogue; the exhibition and concurrent workshop at the Max Planck Institute for the History of Science, Berlin in August 2007 present the final results of the Seminar.

The guiding idea behind the Wandering Seminar was to explore new ways of bringing together the history of science, medicine, and technology as a scholarly discipline with museum collections and exhibitions of objects that have figured in those histories. Traditionally, the worlds of the scholar and the museum curator have existed apart from one another, formed by different training and addressing different audiences. But in the past decade or so, this situation has changed dramatically: historians and curators often share similar academic backgrounds [and shuttle back and forth between the university and museum in their careers]; historians have paid increasing attention to the role of material culture and sites of scientific inquiry [the laboratory, the field, the museum]; and curators have envisioned exhibitions as both public events and contributions to research. The challenge to the Wandering Seminar was to re-think the ways in which concrete, three-dimensional physical objects could be integrated into a history that has been largely narrated as one of concepts and theories.

This was a challenge to engrained ways of seeing, thinking, writing - and also to sheer physical stamina. In a few jam-packed weeks, the seminarians visited some of the leading collections of scientific objects in Europe, in Munich and Copenhagen, Florence and London, Berlin and Cambridge, Oxford and Basel, Paris and Winterthur, Pisa and Zurich. They heard lectures, toured exhibitions, went “backstage” into storage rooms, conversed with curators, handled the oddest objects - all with great stores of critical curiosity and precious little sleep. The result was an intense, sustained, and - as this catalogue bears ample witness - immensely fruitful meditation on how the ways in which the history of science and science museums might be conceptualized, visualized, indeed physicalized in new kinds of narratives that do justice to the central yet neglected role of objects.

On behalf of the members of the Max Planck International Research Network, I would like to thank the participating Network member institutions [Cambridge University, the University of Pisa, the ETH Zurich, the Humboldt University Berlin, the Technische University Berlin, the Centre Alexandre Koyré in Paris, the Deutsches Museum in Munich, the Institute and Museum of the History of Science in Florence, and the Max Planck Institute for the History of Science in Berlin] as well as the cooperation partners in the Wandering Seminar: The Medical Museion in Copenhagen, the Medical History Museum in Berlin, the Museum of the History of Science in Oxford, the Eikones project at the University of Basel, the Naturmuseum in Winterthur, and the Science Museum London. Network Coordinator Hannah Lotte Lund royally earned her title of “Coordinator” by arranging and re-arranging the logistics of the Seminar on a tight budget; the idea of the Wandering Seminar was the inspiration of Dr. Christine von Oertzen of the Max Planck Institute for the History of Science, who also laid the groundwork for its format. Most of all, I would like to thank the seminarians themselves for their imagination, perseverance, and élan. I look forward to keeping track of their future activities as scholars, curators, and scholar-curators, who will, I am confident, “objectify” the history of science in a wholly new sense.

Lorraine Daston
Max Planck Institute for the History of Science, Berlin
July 2007
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We would like to thank

our fellow Wanderers; Gerd Brinkhus, Universitätsbibliothek Tübingen; Jochen Brüning and Thilo Habel, Hermann von Helmholtz-Zentrum für Kulturtechnik, Humboldt Universität zu Berlin; Bärbel Fest, Polizeihistorische Sammlung Berlin; Jan von Brevern, ETH Zürich; D. Graham Burnett, Princeton University; H. Walter Lack and colleagues, Botanisches Museum Berlin-Dahlem, Freie Universität Berlin; Elke-Barbara Peschke and Imbritt Wiese, Universitätsbibliothek, Humboldt Universität zu Berlin; Ilsabe Schalldach, Erfurt; Wolfgang Steguweit and Elke Bannicke, Staatliche Museen zu Berlin, Münzkabinett; Peter Wolff, Universitätsbibliothek Greifswald; Moritz Wullen, Staatliche Museen zu Berlin, Kunstbibliothek; Anke te Heesen, Museum der Universität Tübingen; Josephine Fenger, MPIWG; Norbert Fiebig, MPIWG; Thomas Schnalke, Medizinhistorisches Museum der Charité Berlin; Rainer Kaufmann and Mark Rosinski, Berlin; Ines Drescher and Gerhard Scholtz, Institut für Biologie, Humboldt Universität zu Berlin; Clemens Jank; the staff of the MPIWG’s library and digi-group; Claudia Paass, Hannah Lotte Lund, MPIWG Berlin; Claudia Schuster and colleagues, Deutsches Technikmuseum Berlin; Heidi Schindler, Institut für Biologie, Freie Universität Berlin, Ferdinand Damaschun and colleagues, Naturkundemuseum, Berlin; Alessandro Pajewski, University of Chicago; Lisa Newble, Ruth Harry and the staff of the Whipple Museum of the History of Science, Cambridge/UK; Lorraine Daston and the members of the Max Planck Research Network „History of Scientific Objects”.
Scientific objects are products of their local and historical context. Scientific attention is directed towards everyday things and phenomena. It transforms these into scientific objects through techniques and tools which are created specifically for the purpose, or which are adopted from other fields of practice. This appropriation changes the appearance and material constitution of the objects. Simultaneously, however, objects resist such transformations through their own materiality, and in turn have influence on techniques and tools. Thus modified, these techniques and tools can be applied in other fields, and generate new knowledge. Generally, objects only remain in a scientific context for a limited amount of time. When they are no longer the centre of scientific attention they may re-enter the realm of everyday things. They may simultaneously be found in other areas of knowledge, and in everyday life. Frequently, public attention is drawn to scientific objects. They can appear in museums, as cultural icons, or in commercial contexts, and thus potentially lose their scientific character.

In May/June 2006 the Max Planck Institute for the History of Science conducted a seminar within the framework of the new international research network “History of Scientific Objects”. For eight weeks, fifteen junior scholars and curators travelled around Europe to encounter collections of scientific objects, and to investigate scientific objects in museums and in scientific practice. The central claim of this exhibition is that scientific objects are locally and historically context-dependent; it stems from our experience in situ. On our visits to numerous institutions and their collections we were confronted with the multi-faceted, problematic nature of scientific objects. Rather than taking the “scientificity” of specimens, instruments, and representations for granted, our exhibition aims to draw attention to the variety and unpredictability of the features of scientific objects. To do this, we highlight their transitions into different cultural, disciplinary, or institutional realms.

Objects of scientific interest are difficult to grasp. Material objects may be too big, or too small, to be easily observed. Phenomena may happen too fast, or too slowly for easy observation. How, then, can scientific objects be exhibited? Science responds to these problems by transforming the objects under scrutiny. Their size is changed, e.g. by taking a part of the object to stand in for the whole, or by producing models (usually in a different material). Processes become observable by representing episodes in a model, or by accelerating the results of long-term developments by technical means. Such transformed objects, preparations, models, images, and data are the palpable, physically manipulable materials of science. Their juxtaposition shows scientific practice as a sequence of various, emerging forms of the production and transformation of scientific objects. Science uses various techniques, instruments and tools for such transformations. Some of these tools are adopted from other scientific fields, or from everyday life. They are applied to the object, and may have to be themselves transformed for this task. This changed form may then invite or enable new kinds of scientific enquiry. Instruments, techniques and tools are also suitable for exhibition. Since they are rarely tied to only one particular type of object, their presentation can highlight the numerous relationships into which a scientific object enters during its “career”. For an appropriate visualization of this network of relationships we therefore include non-scientific objects, such as works of art, commodities, or souvenirs.

This juxtaposition highlights the fact that knowledge about things is produced in many different realms, such as religion, art, or commerce. This origin may pose challenges for objects’ subsequent mobility into scientific enterprises. In cases where things or materials initially attract interest for commercial reasons, for instance, the very materiality of the objects which first prompted this attention may at the same time be problematic for their subsequent incorporation into scientific enterprises. Both whales and geological formations, for example, are first grasped by those who exploit these objects as natural resources. (fig. 1) Considerable knowledge about them, as well as skills and instruments for handling them, were accumulated by hunters and artisans well before the emergence of modern scientific enterprises. Indeed, one fruitful way for analysing such objects from...
a historical perspective is to ask how different [intellectual or practical] interactions with such objects shape our very conception of modern science: How does modern science define itself through the use of objects? Looking at these articulations traces the history of the demarcation of scientific practices from those of other knowledge traditions. A history of the material practices and concomitant knowledge surrounding an object during its transition into “science” illuminates the various elements which contribute to an object’s mobility, or lack thereof. At the same time, comparisons between different objects’ trajectories can be used to highlight the fact that the success or failure of such transitions is highly contingent. No set of elements can ever be determined to predict an object’s success in the scientific realm.

Two related elements of the transformation of things into “scientific objects” deserve increased attention in connection to our own experiences as exhibition makers: first, the problems caused by the materiality of objects, and second, the role of information management around them. The very material properties which originally made a natural object (such as the whale) interesting, e.g. for commercial or religious reasons, may pose challenges for its incorporation into scientific enterprises of knowledge production. The sublime awe-inspiring spectacle of the whale was due to its being both extremely large, and a living being. These characteristics, however, are not conducive to analysis in the kinds of social and spatial settings which were used to define emerging science against other (artisanal, religious) knowledge traditions. The large size of an object, for instance, precluded its analysis in a genteel, indoor setting considered appropriate for scientific engagement. While the anatomist John Hunter, for example, made anatomical observations of whales based on his observation [together with spectacle-loving crowds] of a whale beached in London, increasingly analysts at tempted to find ways to bring the object into their own sphere in acceptable forms. This required material transformations, or the production of “immutable mobiles”.

But does such a thing really exist? The biography of a scientific object indicates that objects constantly have to transmute, to be adapted to changing [conceptual, institutional, or cultural] circumstances of knowledge production, in order to remain useful for scientific enquiry. By the same token, physical immutability does not guarantee the mobility of scientific objects – under changing circumstances. An object previously accepted as scientific may well lose this status.

These qualifications notwithstanding, Latour’s concept of the “immutable mobile” can be taken to indicate, not so much a “real” necessity for immutable mobiles for the production of knowledge, than that scientists themselves in their discourse about the epistemic value of material things put great emphasis on the features of immutability and mobility. This leads us to the role of information management. While it would be difficult to find examples of objects which do remain absolutely immutable during their transitions into scientific work, it is illuminating to analyse the strategies that go into arguing that objects do remain “the same” during such transitions. Modern science needs to maintain the claim that its objects are “just like they are in nature” in a meaningful way – the post-Anistotelian debate whether “forced” experiments do in fact correspond to “natural” processes has only been transferred to other areas of knowledge production. Can a laboratory-based “model organism” such as *drosophila* tell us anything about genetic phenomena in wild populations? Various examples of objects’ trajectories and transmutations show how information management, the judicious revelation or hiding of information around an object, can make or break an object’s scientific status. This may include the addition of Latin names on labels, or the omission of sources or witnesses deemed inadmissible such as native informants.

But how does the continual mutability of scientific objects agree with their inclusion in an exhibition project as arrested, immobilized things? In the recent discussions within the history of science, museum objects sometimes seem to have a poor standing. Hans-Jörg Rheinberger, for instance, describes scientific objects,
or “epistemic things” as he calls them as basically non-musealizable entities. Epistemic things are the activator and catalyst of scientific novelty. Often brought into being by coincidence, they themselves continuously generate unforeseen events and unexpected results. As long as they have the potential to surprise, they will stay in the focus of research. Due to their unpredictability they synchronically and diachronically move through disciplines, techniques, institutions and scientists’ biographies. Their material context is not congruent with themselves but is simply the means for their visualization. As an object shifts through time and space, its material context also changes. How could an unruly scientific object then ever be exhibited? Its existence in the display case seems impossible. It would manifest the end of its scientific reality.

What, then, does the beholder encounter in History of Science Museums all over the Western world? Is it anything more than an aesthetic self-assurance of science? [fig. 2] According to the definition of epistemic things, the only objects fit to be preserved in museums are the particles of the material contexts the scientific object has been moving through during its life. Those fragments were accidentally chosen, violently modified, abandoned, or celebrated. They soaked up the aura of scientists, institutions, and scientific theories. The material remains therefore represent the past on-site existence of the scientific object and the effects it has exerted on this environment.

It is a useful undertaking to let epistemic things encounter the display case. Exhibitions can circumnavigate the special challenge of the three-dimensional and manifold context of the life-stages of a scientific object. Since the biography of the scientific thing dissolves the temporal and spacial boundaries between disciplines, practices and individuals, a linear narrative becomes impossible. An exhibition can be turned into a media to illustrate this multifaceted history in a visual narrative. The concomitance of objects in a room represents the synchronal and diachronal transitions of a scientific object. A careful selection of remnants of the material context stands for the periods of scientific life between coming into being, transformation, marginalization and neglect. The juxtaposition of objects with features of similitude or otherness, familiarity or strangeness associates the coincidence, the surprise and the unthought-of as basic principles of scientific things.

Exhibitions can become an invitation to scrutinize what is held to be the scientific or, rather, what the scientific should look like. [fig. 3] As in writing the biographies of scientific objects, aspects are brought together that in reality seldom meet openly. Thereby objects on display somehow pick up the innovative oscillation of the scientific object, and generate new insights and ideas.

Can the mobility of objects be grasped analytically or through spatial juxtaposition? With analytical concepts such as the “boundary object”, historians have singled out objects’ pliancy and adaptability, but also their standardisation as criteria for the circulation of objects among disciplines. Nature self-printing, an imaging technique printing from originals used in botany, offers an opportunity to investigate the dynamics of this mobility and to analyse the characteristics of objects positioned at the boundaries between multiple disciplines and at the origin of multiple uses. In order to grasp this mobility one can compose a field in which the images produced with this technique are in relationships of proximity and simultaneity to each other. This spatial array permits one to grasp their declinations, and activates their mobility. [fig. 4] This approach is inspired by Aby Warburg’s “Bilderatlas” and also by the suggestions offered by museum storage spaces, where objects belonging to the same type are preserved on shelves. They thus form series which enable an understanding of the multiplicity of the uses and trajectories of which their material form is at the same time an historical trace and an historical actor.

Having constructed such a field, different uses can be distinguished. Next to botanical books one finds banknotes, next to leaves placed in a structure which indicates an attempt at classification, one finds leaves which cover an entire folio page of a luxury publication. The contrasts and resemblances put in relief by this proximity reveal the oscillation of these objects and allow an initial mapping of their mobility.

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The mobility of the nature self-print (Naturselbstdruck) not only depends on the features of the image, but also on the techniques used for its production. These techniques changed their relationship to science between the eighteenth and the nineteenth century. In the eighteenth century, nature self-printing was developed especially in botany to produce images that were accurate and true to nature, and thus could be used for scientific investigations. At the beginning of the nineteenth century, however, the technique became somewhat autonomous from science. Since it began to compete with photography, nature self-printing presented itself as technique of trustworthy images by appropriating complex objects from botany such as the nervation of leaves, and others such as lace, to demonstrate its qualities. This “autonomization of the technique” through science created new mobilities and boundaries.

An analysis of nature self-printing which is sensitive to the images and techniques allows us to grasp the different dynamics which mobilize an object. Such an approach draws attention to the limits of the normative notion of the boundary which makes it difficult to account for objects’ transitions, and for the reconfigurations of knowledge produced by objects which confound disciplinary territories. Objects are more itinerant than one may think.

To showcase this vagrancy of objects the exhibition combines three case studies on specific objects (the earth, whales) and techniques (nature self-printing), which are described in the catalogue section. In addition, scholars from different fields (museology, science, history of science, history of art) offer their own reflections on these topics.

In her introductory essay, Anke te Heesen explains how the increasing interest in historical scientific collections has been productive for prompting historians of science to think about the role of material objects in scientific enterprises. She further elaborates the three central analytical concepts which we have briefly touched on: the “boundary object” (Star and Griesemer), the “immutable mobile” (Latour), and the “epistemic thing” (Rheinberger), and highlights the multi-faceted nature of “scientific objects”: the simultaneity of meanings, uses, and loci. Graham Burnett uses a critical juncture in science’s occupation with whales, the 1963 First International Symposium on Cetacean Research, to present a multiplicity of approaches to whales as objects of scientific knowledge. He highlights how these approaches and their presentations contributed to a fundamental change in the public perception of the “leviathan”. The contribution of Walter Lack traces the fate of the little-known nature prints of the Humboldt-Bonpland expedition. He shows why the naturalists chose this technique, which was not standard practice in the field, and illuminates the images’ various geographical and institutional trajectories. Jan von Brevern explores the history of the perception of the Blue Rock, an erratic boulder at Saas Valley in the Alps. Its career from a material scientific argument in glacier research to a touristic landmark coincided with the advent of photography and its commercial and scientific usages.
Interest in whales precedes modern scientific enterprises. In medieval and early modern Europe, whale jawbones and narwhal teeth in church treasures and collections of *mirabilia* gave rise to speculations about giants and unicorns. Martin Luther famously used a whale vertebra as a footstool during his sojourn on the Wartburg. Questions of classification were always of practical importance, e.g. in the medieval classification of dolphins and whales as fish, which made them permissible food on fast days. But knowledge of whales is hard to obtain. While most of us are capable of identifying a few whale species correctly, to the present day, very few have ever seen a living animal with their own eyes. Like John Hunter, whose 1787 *Observations on the Structure and Economy of Whales* was a milestone for the description of whale anatomy, we are still dependent on collections of fragmented specimens and of stranded animals. Even those who had first-hand experience with whales struggled to describe and define such vast, powerful creatures. Herman Melville, who had been employed on a whaling ship himself, vividly describes his troubled attempts to give an account of the whale, the largest animal on Earth.

Contemporary work in Science Studies frequently analyses the genesis of scientific objects by focusing on microscopic, or even immaterial entities: how is the invisible made visible, and how is it made into an object of scientific observation? By contrast, “Leviathan in the box” asks what kinds of challenges are posed by macroscopic objects such as whales – how does the whale become a scientific object? How can one collect, document, and archive whales? What challenges are posed by the whale’s size? How does one turn a living being into a scientific object? How is one to investigate an object whose habitats are vast, deep oceans? The display’s focus is not primarily on scientists’ economies of attention, but problematizes the materiality of the whale. It aims to show that visualizations of micro- and macroscopic objects have many things in common: it is as difficult to make a whale visible as a scientific object as an electron. In addition, the display highlights the simultaneity, and inseparability, of scientific and commercial interests in whales throughout most of whaling’s history.

“To grope down into the bottom of the sea after them; to have one’s hand among the unspeakable foundations, ribs, and very pelvis of the world; this is a fearful thing. What am I that I should essay to hook the nose of this Leviathan! The awful tauntings in Job might well appal me. “Will he (the Leviathan) make a covenant with thee? Behold the hope of him is vain!” But I have swum through libraries and sailed through oceans; I have had to do with whales with these visible hands; I am in earnest; and I will try.”

Herman Melville, *Moby Dick* (1851)

Oceanography pioneers John Murray and Johan Hjort published this image of a piece of sperm whale skin with sucker marks in *The Depths of the Ocean: A General Account of the Modern Science of Oceanography Based Largely on the Scientific Researches of the Norwegian Steamer ‘Michael Sars’ in the North Atlantic* (London: Macmillan and Co, 1912), p. 653 (fig. 486). The scars were taken as proof of submarine battles between sperm whales and giant squid – with this object, the whale itself became a recording device for events which scientists could not observe.
Miniatures

1.2 Chamisso’s whale model “Kuliomoch”
1817; Kamchatka, Aleutian Islands
wood and labels; 3.9 x 3.4 x 15 cm
Museum für Naturkunde, Humboldt University, Berlin

From 1815 to 1818, the poet and naturalist Adelbert von Chamisso travelled on board of the Russian “Rurik” in the Pacific and the Bering Sea, where a native tradition of whaling had long been established. He had nine miniature models of different whale species made by “experienced Aleuts” at Unalaska. Chamisso used these models, together with his own observations and reports he collected for a scientific publication on whales. His paper was published with illustrations in 1824 (see fig. 1) in the proceedings of the Leopoldinische Akademie.


1.3 model of a humpback whale calf
_Megaptera novaeangliae_
ca. 2006, China
vinyl; 15 x 6 x 3 cm
private collection

The toy company Safari produces these models, on a scale of 1:40, with the authorization of Monterey Bay Aquarium. The model is accompanied by a booklet containing brief information.
Leviathan in the box: Collecting Whales

Pieces – traces – tools

Anatomist John Hunter’s 1787 *Observations on the Structure and Economy of Whales* was based on his observations in collections, and on stranded whales and dolphins. Frequently, however, descriptions of whales were published by surgeons on whaling ships, e.g. Thomas Beale’s *Natural History of the Sperm Whale* (1839) and Frederick Debell Bennett’s *Narrative of a Whaling Voyage Round the Globe, From the Year 1833 to 1836* (1840), or by whaling captains themselves, including the seminal 1820 *Account of the Arctic Regions, with a History and Description of the Northern Whale-Fishery* by William Scoresby Jr. In addition to anatomical and natural historical approaches, scientists and fisheries experts alike increasingly turned their attention towards ecological considerations, especially after the British *Challenger* expedition of 1872-76 which was central for the birth of the new discipline of oceanography.

1.4 Cutting-in pattern

1837, London
(see introduction, fig. 1)

This pattern for “cutting-in” or flensing sperm whales at sea was first published in James Colnett’s 1798 *Voyage to the South Atlantic and Round Cape Horn into the Pacific Ocean, for the Purpose of Extending the Spermaceti Whale Fisheries, and other Objects of Commerce*. It was originally a contribution to British attempts to develop specialized knowledge about the commercial hunt for sperm whales, after American independence had deprived Great Britain of its sperm whale fishery in the colonies. Subsequently the pattern, and occasionally the cutting tools, were reproduced both in accounts of whaling and in texts about the natural history of the whale, as in this case.


1.5 “Whaling: flensing of the whale”

1898, Berlin
Meisenbach, Riffarth & Co.
paper; 11 x 7 cm
collection of Clemens Jank

From 1873 to 1940, the Liebig Extract of Meat Company founded in 1865 by the chemist Justus von Liebig (1803-73) successfully advertised its meat extract through thematic series of collectible images, ranging from exotic animals and plants to industrial scenes and operas. The series were printed in high-quality chromolithography, and became very popular with collectors. This image of flensing is part 5 of a series of images on commercial whaling.
This large (thoracic?) vertebra of unknown origin is currently part of the teaching collection of the Department of Comparative Zoology. Due to its large size it is well suited to demonstrate general vertebra structures, e.g. in combination with wall charts. Whale vertebrae have been known to serve a variety of uses – in a famous example as a footstool in Martin Luther’s study on the Wartburg.

This wet specimen of a bisected eye of a blue whale was collected in 1898 by the naturalist Fritz Schaudinn (1871-1906) on his joint expedition to Spitzbergen with Fritz Römer (1866-1909), later director of the Senckenberg-Museum in Frankfurt am Main.
1.8 larder beetle
*dermestes lardarius*
Museum für Naturkunde, Humboldt-University Berlin

Colonies of dermestid larvae and beetles are widely used to remove flesh from osteological specimens.


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1.9 whale penis
unknown species
dry preparation; length 220 cm
Museum für Naturkunde, Humboldt-University
Inv. no. ZMB 89290

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1.10 harpoon
c. 1850, US-American
single-flued iron; length 102 cm
collection of Clemens Jank

Whaling cultures from the Basque to the Alaskan peoples have used various types of harpoons for over a thousand years to capture whales before killing them with lances. The single-flued iron was an early-nineteenth-century improvement over the two-flued iron used traditionally in European and American whaling, the shape of the tip embedding the harpoon more securely in the whale’s flesh. The introduction of harpoon guns and exploding harpoons from the mid-nineteenth century gave whalers and naturalists access to faster, stronger species.
John Murray, John Hjort
London, 1912

Figure 573 shows the distribution of whales, and temperatures at a depth of 100 metres. The chart was drawn by A. Howard Clark, officer in charge of the United States Fish Commission, using the Commission’s records and data from the German Valdivia expedition of 1898-99. In The Depths of the Ocean, a foundational text for the discipline of oceanography, Murray and Hjort used whale species as indicators for the distribution and abundance of animal life in the oceans, according to whale species’ feeding habits. They came to the conclusion that “the scientific investigation of an ocean must commence with observations of a qualitative kind” (p. 783). As with the traces of sucker marks on skin [see 1.1], here too the whale is evidence for phenomena which are not directly accessible.

The Fisheries and Fishery Industries of the United States (Washington DC: United States Commission of Fish and Fisheries 1884-1887).

Commodities

Whales were valued as resources for various materials; all parts of the animal were put to use, from skin and blubber to baleen and bones. The oils of baleen whales and sperm whales were turned into margerines and soaps, crayons, and lubricants. Baleen (“whalebone”), the plates attached to the palate of baleen whales, was used for hoops and corsets. Whale meat (and bones) were processed into animal feed.

1.12 narwal and unicorn

Pierre Pomet, Der aufrichtige Materialist und Specerey-Händler: oder Haupt- und allgemeine Beschreibung derer Specereyen und Materialien, worinnen in drayen Classen, der Kräuter, Thiere und Materialien […] begriffen und enthalten ist (Histoire générale des drogues 1694) Leipzig, 1717

In the Middle Ages and the early modern period, the horn of the unicorn or narwhal tusk was an expensive medicinal agent held to be useful as an antidote or aphrodisiac.

Before the triumph of feather-steel, baleen’s combination of flexibility and toughness made it a much sought-after material for a diverse range of products from corsets to fishing rods.

“Sunlight soap”, produced in Great Britain since 1884 by Lever & Co., and in Germany since 1899, was one of the many mass-produced goods in the late nineteenth and early twentieth century to use whale oil.
In the 1970s and 80s, organizations such as Greenpeace turned the whale into an icon of the environmental movement. Through merchandise ranging from buttons to “Save the Whales!” mugs, iconic whales have become items of conspicuous consumption and objects of public concern.

The use of baleen in brush-making was originally patented by Samuel Crackles in 1808. The brush industry subsequently became one of the main consumers of baleen in the nineteenth century.

Part of the whaling industry of New England, the F.W. Nye Oil Factory was established on Fish Island in 1866. Until 1978, the company used the oil from blackfish as the basis for a widely sold brand of high-quality lubricating oil for precision instruments such as watches, clocks, and chronometers.

1.18 button "stop killing!"
2007
metal, paper; diameter 4 cm
collection of Clemens Jank

1.17 Nyoil bottle
1920s
metal; 12 x 6 x 2 cm
collection of Clemens Jank

1.16 hairbrush
cia. 1930
baleen, wood; length 25 cm
collection of Clemens Jank

1.15 button "whale"
2007
metal, paper; diameter 4 cm
collection of Clemens Jank
The nature self-print

Nature self-printing is an imaging technique which prints directly from the original object such as a plant leaf. The first account of this technique, the “Dioscurides” manuscript at the Topkapi Museum in Istanbul, dates from the thirteenth century. Various examples of nature self-prints are known for the fifteenth to seventeenth centuries, but it was especially during the eighteenth and nineteenth century that the technique attracted interest in the field of botanical imaging, while remaining at a limited circulation. The use of self-printing offered a solution to two kinds of problems encountered by botanists: the conservation of herbariums [see the article by H. W. Lack in this volume], which were frequently destroyed by insects, and the production of images that were both accurate and affordable.

Between the end of the nineteenth and the beginning of the twentieth centuries, “objectivity” became established as the core principle of scientific research. It integrated several earlier ideals of scholarly practice, among them the notion of “truth to nature” (Daston and Galison 1992, p. 84). This feature of representations, which constitutes a necessary precondition for the production of scientific images, is at the origin of the diffusion of nature self-printing in botany. Eighteenth-century scholars searched for an imaging technique which overcame the limits posed by the subjectivity of the artist, and by the construction of ideal types for botanical illustrations (Nickelsen 2000, p. 159).

However, the images printed with this technique show how the exigence of truth to nature went beyond the sphere of science. Due to their precision, to the values of authenticity and uniqueness which they embodied, these images moved from science to art, and from the discovery of the self to police control.

This mobility also depended on a transformation of the printing method between the eighteenth and the nineteenth century which modified the relationship between science, technique, and represented object. In the eighteenth century, botanists used nature self-printing for the accurate reproduction of complex structures such as the nervation of leaves. In the nineteenth century, imaging techniques such as photography and nature self-printing turned to complex objects which could demonstrate their advantages. This is evident, for example, in William Henry Fox Talbot’s (1800-1877) *The Pencil of Nature* (1844), and in Alois Auer’s (1813-1869) *Die Entdeckung des Naturselbstdruckes* (1854) which showed not only the nervation of plants leaves, but also laces.

The following section presents this transition with a few examples of nature self-prints from the eighteenth and nineteenth centuries.

This photograph was produced by the inventor Johann Carl Enslen (1759-1848) and published in his *Versuch, die Natur des Lichtes aus seinen Erscheinungen zu erklären* (1841). It represents the nervation of an oak leaf on which is superimposed a bust of Christ. This motif established a dialogue with the technique of nature self-prints, with which Enslen was probably acquainted from articles published between 1809 and 1811 in the *Bulletin des Neuesten und Wissenswürdigsten aus der Naturwissenschaft sowie den Künsten, Manufacturen, technischen Gewerben, der Landwirtschaft und der bürgerlichen Haushaltung* (Oettermann, 1989, p.130).

The skeleton of the oak leaf recalls nature self-prints made in the eighteenth century, such as the *Nahrungs-Gefäse in den Blättern der Bäume nach unterschiedlichen Austheilung und Zusammenfügung so wie solche die Natur selbst bildet* (1748) by Johann Michael Seligmann (1720-1762) and Christoph Jacob Trew (1695-1769) (see 2.5 and 2.6). By introducing the theme of the Veronica [vera icon, true image], the motif of the image of Christ is also a quotation of nature self-printing. According to medieval legend, the true image of Christ remained imprinted in a towel which Saint Veronica had used to dry his face during the ascent to Calvary. The gesture towards the authentic image of the Saviour thus recalls the technique of nature self-printing which was used for the production of botanical images. Represented on a photograph, a technique which came to assume the monopoly of “faithful” reproductions of nature in the nineteenth century, these motifs delineate the tradition into which nature self-printing inscribed itself.

The techniques

The technique of nature self-printing was transformed between the eighteenth and nineteenth century. In the eighteenth century, the leaf to be printed could be prepared by pressing, or by leaving it in water before removing the parts which covered the nervation. After spreading a thick ink on a plate, the prepared leaf was dipped in paint and printed on it. As Ernst Wilhelm Martius [1756-1849] explained in his Neueste Anweisung, Pflanzen nach dem Leben abzudrucken [1784], the procedure varied according to the preparation of the plant, the paint, the plate, the paper, and the pressure used for the production of the image. The Quigenta specimen herbarum et florum ad vivum impressa [2.3] of Johann Hieronymus Kniphof [1704-1763] and Die Nahrungs-Gefäse [2.5] of Seligmann and Trew show examples of these techniques.

The process changed again in the nineteenth century. The necessity to print a larger number of copies without compromising the quality of the image was added to the precision of reproduction. This requirement was at the origin of the combination of nature self-printing with gravure printing and lithography [Geus 1995, p. 22-23]. With this new method, the object initially leaves an imprint on a metallic carrier, which is subsequently used for the reproduction on paper. Major progress in this direction was achieved around the middle of the century by Auer, who used galvanization and stereotype to fix the imprint on a metallic carrier and thus reproduced it in large numbers. Auer used gutta-percha, a rubber-like material introduced to Europe in 1842, to apply this technique to voluminous objects, taking an imprint before galvanizing it [2.12]. One example of the botanical application of the process developed by Auer is the Physiotypia Plantarum Austriacarum, der Naturselfdruck in seiner Anwendung auf die Gefässpflanze des österreichischen Kaiserstaates [1873] of Constantin von Ettinghausen [1826-1897] and Alois Pokorny [1826-1886] [2.4]. During those years, other scientific disciplines experimented with this technique as well. In 1845, Wilhelm Haidinger [1795-1871] published his Handbuch der bestimmenden Mineralogie, in which he used the process for printing the surfaces of meteoric irons [cf. also 3.8].


2.2 Neueste Anweisung Pflanzen nach dem Leben abzudrucken
Ernst Wilhelm Martius
Wezlar, 1784

2.3 Quigenta specimen herbarum et florum ad vivum impressa
Johann Hieronymus Kniphof
first half of the eighteenth century
pl. 457
Universitätsbibliothek, Humboldt-University Berlin
Call no. 2813 an:2:F2

Johann Hieronymus Kniphof [1703-1763], director of the University of Erfurt, and professor of anatomy, surgery and botany, was the author of the Botanica in originali [1757-1764], a publication aimed at dilettantes rather than at savants. The Quigenta specimen herbarum et florum ad vivum impressa, with its 500 uncolored nature self-printed botanical tables, is a collection of nature self-prints attributed to Kniphof. In this text, the handwritten labels are descriptive Latin names which do not yet refer to the Linnaean nomenclature; this indicates an origin before 1753. Kniphof’s interest in nature self-printing, for which he developed a new method, was necessitated by his aim to learn botany from nature itself. His attempt can thus be seen as a critique of existing systems of representation which used drawings and texts. Only in the last copies of Botanica in originali did Kniphof use the clas-
sification developed by Carl von Linné (1707-1778) in his *Species plantarum* (1753) [Lenné 2002, p. 114]. The *Quingenta specimina* is remarkable for its representation of the finest plant hairs, but also of voluminous plant parts such as succulent sprouts and roots.

For the upcoming universal exhibition in 1854, C. von Ettinghausen and A. Pokorny were charged with the production of 500 botanical tables using nature self-printing in order to highlight the scientific interest of this kind of print. According to the original plan, the *Physiotypia Plantarum Austricarum* should have consisted of 3000 tables representing the Austrian flora. However, due to enormous expenses the printing was limited to 500 tables. In their introduction to the *Physiotypia*, the authors highlighted the advantages of this technique for the representation of plants: “first a true original representation, second measurements of dimensions and angles, just like in real plants, and thirdly (…) anatomical preparations and analyses, which are difficult or impossible to produce in any other way, and which can never be represented so true to nature in a graphical manner” [p. XXII]. Despite its scientific ambitions, the work came out in a luxurious edition published in a folio format. The authors did not hesitate to draw attention to the aesthetic character of those images which represented faithfully the beauty, the detail, and the perfection of the object. In 1856, von Ettinghausen and Pokorny used this technique in their *Die wissenschaftliche Anwendung des Naturselbstdruckes zur graphischen Darstellung von Pflanzen* to compare the nervation of fossil plants to those of the Austrian flora in order to explore “whether it was possible to establish a natural classification of plants according to vegetative characteristics” [Lenné 2002, p.115].


2.4 *Physiotypia Plantarum Austricarum*, der Naturselbstdruck in seiner Anwendung auf die Gefässpflanze des österreichischen Kaiserstaates

Constantin von Ettinghausen, Alois Pokorny

Prague, 1873

vol. 3, pl. 215

Bibliothek am Botanischen Garten und Botanischen Museum, Berlin-Dahlem, Free University Berlin

Call no. Gr 581.4
**Authenticity and uniqueness**

The process employed by Seligmann and Trew for *Die Nahrungs-Gefäße*, in which the fragile nervation was laid bare, destroyed the leaf after one impression, and thus required their continuous replacement. Therefore each copy of the book is in a way unique (2.5 and 2.6), which made the standardization of the image impossible. This standardisation however was the prerequisite for images’ use in scientific research, because “unrefined natural objects are too quirkily particular to co-operate in generalizations and comparisons” (Daston and Galison 1992, p. 85). This uniqueness of images produced by nature self-printing resonates with other uses of printing which are considered true and authentic signs of the self. Children dip their hands in paint and their prints on a sheet of paper constitute an important discovery of their individuality. Fingerprints, which preserve the complex and individual patterns of the body, are at the origin of the system of identification used in policing since the early twentieth century (2.7). The individuality of images produced with nature self-printing also explains its use in the eighteenth century to prevent the forgery of banknotes (2.8 and 2.9). The complexity and uniqueness of the nervation of a printed leaf made the forgery of notes practically impossible. The principle of truth to nature is thus related to other qualities of the nature self-print, its uniqueness and authenticity, which allows us to grasp the images’ mobility and the multiple uses of the technique. Indeed, the leaf’s nervation, reproduced by nature self-printing, moves from botany to banknotes. The technique is used both to create scientific objects, to discover one’s own individuality, and to identify criminals.


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Die *Nahrungs-Gefäße* was the product of a collaboration between the Nuremberg physician C. J. Trew and M. Seligmann, engraver and student at the city’s art school. Eighteenth-century botanists were interested in the anatomy of plants and in the systems of vessels which ran through the leaves. Those structures became better known through observations with magnifying glasses and solar microscopes (cf. 3.18), but were difficult to represent accurately in drawing. With nature self-printing one could retain those structures and engage in the study of “1) the disorder of vessels which distribute the nutritious sap in each leaf, 2) the vesicles in which these vessels end, and which fill the space (spatia) between the vessels; 3) the membrane which covers the vessels and vesicles from above and below”. The results of this printing technique are very pretty. The leaves, prepared and printed using Bolus paint, are framed by a decorative cartouche of shells and leaves. To make the image clearer and more readable, a small asterisk indicated to the reader that an image was the print of the back of a leaf.
2.6 Die Nahrungs-Gefäße in den Blättern der Bäume nach unterschiedlichen Austheilung und Zusammenfügung so wie solche die Natur selbst bildet
Johann Michael Seligmann/Christoph Jacob Trew
Nürnberg, 1748
pl. XVI
Universitätsbibliothek Greifswald
Call no. 521/Td 305c 2°

2.7 fingerprints
1959
Polizeihistorische Sammlung beim Polizeipräsidenten in Berlin

2.8 One Shilling
Burlington, New Jersey, 1776
banknote
Staatliche Museen zu Berlin, Münzkabinett
Alte Sammlung

Benjamin Franklin (1706-1790) printed the nervation of leaves onto banknotes by nature self-printing to combat counterfeiting, which threatened the monetary system of the American colonies. Known as a politician, savant and inventor, Franklin was above all a printer. In the course of these activities he met Joseph Breitnall. Between 1730 and 1733, Breitnall assembled a collection of nature self-prints after having learned the technique, probably from Franz Daniel Pastorius (1659-1720). During his stay in England between 1724 and 1726, Franklin frequented the house of Sir Hans Sloane (1660-1753), where he had the opportunity to see other examples of the technique. During those years he may also have encountered a method developed at Edinburgh which allowed one to print a leaf onto a metal plate [Geus 1995, p. 17]. Banknotes with printed leaf nervations were introduced in Pennsylvania in 1739 and in Delaware and New Jersey in 1746.


2.9 One Shilling
Burlington, New Jersey, 1776
banknote
Staatliche Museen zu Berlin, Münzkabinett
Alte Sammlung
Accuracy: science, art and industry

Images produced by nature self-print are characterized by their precise and detailed rendering of structures, a transparency of the results which in part explains their mobility. This precision is one reason for the scientific utility of these images; on their basis botanists carried out morphological and comparative studies. This technique allowed for the visualization of apparently invisible qualities of the object by using the object itself in the printing process. Indeed, nature self-prints were used just like preparations for microscopical observations (2.14). At the same time, the precision of this method of printing prompted aesthetical considerations of these images. Botanical treatises which used the technique dwelled on its aesthetic aspects, e.g. *Pflanzenblätter in Naturdruck mit der botanischen Kunstsprache für die Blattform* [circa 1872] of G. Ch. Reuss [2.10]. The images’ faithfulness to their objects was an inspiration for the artistic realism of the nineteenth century.

This aesthetic dimension was a reason for the proliferation of objects reproduced as nature self-prints, and their distribution through media other than scientific texts, such as the popularizing journal *Faust*, which published nature self-prints of bats, algae, and plants (2.11).

2.10 *Pflanzenblätter in Naturdruck mit der botanischen Kunstsprache für die Blattform*
G. Ch. Reuss
Stuttgart, circa 1872
pl. 26
Staatliche Museen zu Berlin, Kunstbibliothek
Call no. J 243 mtl

In the introduction to his *Pflanzenblätter in Naturdruck mit der botanischen Kunstsprache für die Blattform*, G. Ch. Reuss explained the two aims of his work. On the one hand, as a scientific publication, it was to help the botanist to identify, by means of a faithful representation of the leaf, the exact words with which to describe it. According to the author, “the demonstration of principles shall achieve visibility where traditional terminology lacks in precision” [p. 1]. On the other hand, as a work of art, the book presents images whose precision surpasses any imitation done by human hands. These accurate representations should educate the gaze and serve as motifs for drawing masters and draftsmen, engravers and modellers, architects and sculptors, since Nature was, according to Reuss, the “unfailing master” of artists [p. 5].
The spread of nature self-printing in the nineteenth century owed much to Alois Auer von Welsbach, director of the k. k. Hof- und Staatsdruckerei in Vienna from 1841 to 1868. In 1854 he published *Die Entdeckung des Naturselbstdruckes*, in which he wrote on behalf of the technique which he perfected: "On account of its simplicity this process is of more importance than the printing by light and the galvanoplastic [...] Russia has given up Jakobi’s application of the galvanoplastic in the year 1837, and France the Daguerreotipy for general use in the year 1839. Austria has now furnished a worthy pendant to these two inventions!" (p.12) He also founded the journal *Faust, Polygraphisch-ill. Zeitschrift für Kunst, Wissenschaft, Industrie und geselliges Leben*, which appeared from 1854 to 1858, and which published nature self-prints of various objects.
Among the images produced with nature self-printing by the k. k. Hof- und Staatsdruckerei of Vienna, the bat is perhaps the most successful. The transparency and accuracy of the image show how the best results of this technique oscillate between faithful reproduction of an object and artistic realism. The technical realization of this bat has raised a number of questions. Unfortunately there is no description of the process used, but according to one hypothesis some twenty galvanizations must have been employed to arrive at such a result (Heilmann 1997). In the journal Faust, the commentary which introduced the image stressed the scientific importance of an anatomical representation of this little-known animal which was the subject of many tales (p. 38).


2.12 "Naturselbstdruck"
Rhinolophus Hipposerepis Herm.
supplement to M. Auer’s Faust. Polig. Illust. Zeitschrift, 1855
graphic of a bat
Staatliche Museen zu Berlin, Kunsthbibliothek
Inv. no. 7440.16
This self-print was Auer’s reaction to the diffusion in England of printing methods which lace makers could use to avoid sending out fragile and expensive samples to their customers. The presence of lace prints among the productions of the k. k. Hof- und Staatsdruckerei also suggests a reflection on the epistemological character of this object. The complexity of lace structures has always posed a problem for their description and for the formalization of practical knowledge necessary for their production. In addition, due to its complex structure lace offered an opportunity to show off the qualities of reproduction achieved with nature self-printing.

In 1856, the journal Faust published botanical self-prints for observation with a magnifying glass. The commentary to this table remarks that the perfection of this technique is such that the print will retain not only the most superficial characteristics of the plant, but also those invisible to the naked eye [p. 199]. The nature self-print is thus not just a technique to preserve the object, but also a means to refine its investigation, as its application in mineralogy shows (3.8). Compared with the high prices of preparations for microscopic observation, which were in growing demand by scientists and the public alike, nature self-prints offered specimens that were standardised and cheap, and thus ideal for teaching purposes.
The coming into being of the scientific object is complementary to its accessibility. The earth’s crust and its elements are reluctant and cumbersome, gargantuan and midget, often unmanageable or hidden from the eye. Human curiosity digs up, breaks open, collects, modifies, minimizes and maximizes the unruly object of interest. Its metamorphosis follows personal purposes, techniques and tools ready to hand. The struggle with the object unfolds innovative power, improvisation, hope and frustration. Alongside the exciting discoveries and the implementation of scientific theories lurks the accidental, the waste, the commercial and the souvenir.

Groundwork

Out of their everyday existence, some material things manage to attract the spotlight of scientific curiosity. Rocks, for instance, are collected from the ground, classified, labeled. They are attributed an identity and enter, as protagonists, history. But what does its history tell us about the object and, conversely, how does the object illuminate history? How does a mineral sample stand out from others that have the exact same natural features and appearance, only because it bears a handwritten note or is attached to a personal memory? The examples invite to speculate about the epistemological status of objects that are stable matter only in their mere materiality.

Until the 18th century, miners in the Erzgebirge used to call the dark rocks pitchblende, and discarded them as useless waste. In 1789, the mineralogist Klaproth identified a new mineral, uranium, by experimenting with the mine spoils. Again with the pitchblende, the French physicist Antoine Henri Becquerel discovered radioactivity in 1896. Experiments with the pitchblende led the chemist Marie Curie to the discovery of Radium. During the cold war era, the pitchblende became a political issue. Pitchblende was mined on a large scale in the Erzgebirge to provide uranium for the military and civil branches of the Soviet atomic industry. In 1988 it gave its name to the samizdat journal Pechblende denouncing the GDR’s uranium mining and its impacts. (fig. 2) After the political change in 1989, the mining of pitchblende ceased due to lacking demand.
3.2. quartz crystal
St. Gotthard, Switzerland
collection M.H. Klaproth
mineral with original label, 11 x 6 x 3 cm
Humboldt-University Berlin, Museum für Naturkunde
Inv.no. 4852/04

3.3. quartz crystal
St. Gotthard, Switzerland
mineral, 11 x 6 x 4 cm
Humboldt-University Berlin, Museum für Naturkunde
Inv.no. 4850/04

While both quartz samples have been collected at the St. Gotthard mountain in Switzerland, only one of them can, by a handwritten label of the collector, be identified as individual object participating in the course of scientific research. The other sample remains anonymous.

3.4. marble
Acropolis/Athens, Greece
souvenir
private collection

3.5. marble
mineral sample
Humboldt-University Berlin, Museum für Naturkunde
no Inv.no.

The joyful memory of the place and the event of collecting distinguishes the private souvenir from its twin, the scientific sample – or does it not?

3.6 detonation container
1999
a) steel container, 6 x 13 x 13 cm
b) sample chamber, 4,5 x 5 x 5 cm
c) sample layer, 1,5 x 3 x 3 cm
Humboldt-University Berlin, Museum für Naturkunde
no Inv.no.

Research on impact craters demands an artificial reconstruction of the natural circumstances leading to the metamorphosis of minerals.

3.7 blowpipe instrument set
c. 1880, by Max Hildebrand Freiberg Vormals August Lingke
set with modern replacements, case 35 x 20 x 8 cm
Humboldt-University, Museum für Naturkunde
Inv.no. o/33

“…One especially needs: platinum beak tweezers, to hold the sample; pincers, to break off small pieces of the examined mineral; steel tweezers for the deslagging; a hammer made from good and hardened steel; a polished steel ambos; a steel mortar to pulverize the substances; …some triangular files; a knife; small scissors with strong jaws; …drills; …a test tube for the dissolution of composed substances in acid…”

F. Kolbeck, Carls Friedrich Plattner’s Probierkunst mit dem Lötrohre, 8th ed. Leipzig 1927

Access
Violent approaches break up the surface of the stable matter for scientific inquiry. Tools and techniques from other scientific fields – be it chemistry, engineering, or biology – are adapted and modified to blast, decompose, etch and imprint the basic material.
3.8 meteorite with air bladder imprint

meteorite found 1847 at Seeläsgen, Poland
imprint by Gustav Rose, c. 1860
meteorite 5 x 6 x 3 cm, imprint 7,5 x 8,5 x 0,3 cm
Humboldt-University Berlin, Museum für Naturkunde
Inv.no. 1889

Gustav Rose, the inventor of the air bladder imprint, wrote about the coming into being of this special scientific practice: "Widmanstätten had [in 1808] the idea to print etched iron matter just like a typeset in the printing press, and fully succeeded. He therefore was able to deliver absolutely nature-like images that art could never produce." (Rose 1864, p. 33f.) Based on this familiarity with natural self printing (cf. section 2 of this catalogue), Rose went even a step further. He impressed the air bladder of a fish onto the etched surface of a meteorite found in Seeläsgen, and put it under the microscope. [fig. 3] More than a century later, a mineralogist resumed the amazing results: "It was remarkable how many details he could observe. By applying this technique he anticipated by three generations the electronmicroscopic replica technique." (Buchwald 1977, p. 455)
Views

Control, regularity, perfection and beauty dominate the models used for capturing the vast and invisible. The visualization depicts not so much the earth’s crust and its components but is rather a means for demonstrating the appropriateness of a scientific theory. As demonstration device and also as visual aid for teaching, simplicity and plausibility of forms is emphasized. Due to the wide spread of models as form of scientific publication, model making became a business, too.

3.9 Thomas Sopwith’s geological teaching models
1841
wood, c. 12 x 12 x 3 cm
University of Cambridge, Whipple Museum of the History of Science
Inv.no. Wh 1581

3.10 foraminifers models
1884, Václav Frič, Prague
plaster, c.12 x 6 x 4 cm
Humboldt-University Berlin, Zoologische Lehrammlung
Inv.no.4.2-8 – 4.2-11

Natural history collections, private collectors and teaching institutions alike were, in the course of the expanding interest in the didactic value of nature during the 19th century, hand-wringingly looking for objects. Frič’s business met the need of the time. Himself an early photographer, he was aware of the potential of image reproduction for science. For the three-dimensional realm of nature, Frič reproduced the whole range of objects from the mineral, vegetable and animal kingdom, and promoted his products during trade fairs all over the world. Foraminifers had been brought into the spotlight of science in the 1820s. Their importance as guide fossils had been widely accepted, after Alcide d’Orbigny (1802-1857) had provided the scientific description of the diminutive unicellular organism – with sets of models as form of scientific publication.


3.11 crystal models
early 19th century, René Just Haüy
china, with original label, 4 x 4 x 4 cm
Humboldt-University Berlin, Museum für Naturkunde
no Inv.no.

3.12 crystal models
early 19th century, René Just Haüy
wood, 10 x 10 x 10 cm
Humboldt-University Berlin, Museum für Naturkunde
no Inv.no.

3.13 teaching model principles of shifting and thrust fault
early 20th century?
wood, 35 x 10 x 20 cm
Humboldt-University Berlin, Museum für Naturkunde
no Inv.no.
Worldviews

René Just Haüy (1743-1822), a French churchman and naturalist, wanted to prove with his beautiful china models nothing less than the regularity of nature as divine creation. Mineralogy for Haüy was “an artwork which, by the mere habit of contemplating and studying it, gains in beauty, where nature appears in a perspective demanding from us the tribute of admiration and awe in the face of its creator.” (Haüy 1804, p.3) Dropping a calcite sample by accident, Haüy had discovered the symmetry of its fractions. This evidential character for an unvariable archetype underlying all creation was taken up by the models. “I believed this work to be a facilitation...to gain such knowledge eligible to adorn reason, to educate the intellect and to excite the soul in fair-minded gratitude for the many gifts nature presents to us at the behest of the charitable divinity.” (ibid. p. 17)


3.14 crystal model
early 19th century, René Just Haüy
china, with original label, 4 x 4 x 4 cm
Humboldt University Berlin, Museum für Naturkunde
Thomas Sopwith (1803-1879), an engineer and trained as cabinet maker, associated with his model thoroughly earthly matter. He attempted national education, economic abundance and stability. In general, he claimed that “an acquaintance with geology is every day becoming more popular, and there is no study that so immediately addresses itself to the enquiring habits of an intelligent mind.” (Sopwith 1841, p. 12) His models were meant as teaching aids for the clever British student on whose shoulders rested the future of the kingdom. William Buckland, the empire’s eminent geologist, declared with view on the models: „The difficulties that arise from the denudation of the upper portions of the dislocated strata, can be adequately expressed only by the solid fac-simile of nature which a model affords. ... By reference to such models, an estimate may, at any time, be formed of the quantity of coal that remains for future consumption; the amount of which will be the measure of the possible duration of our country’s exalted position among the kingdoms of the earth.” (ibid. p. 81f.)


3.15 Thomas Sopwith’s geological teaching model
1841
wood, 12 x 12 x 3 x
University of Cambridge, Whipple Museum of the History of Science
Inv.no. Wh 1581
Insights

Projection and inspection are the demarcations of scientific viewing practice and social behavior of the protagonists. The individual close view through the microscope demands diligent attention and concentration. The instrument is shaping a particular image of science as solitary undertaking, with virtually invisible results depending on the explication of the expert. Projection apparatuses on the other hand imply a gazing community engaging in scientific dispute at the very sight of the object of interest.

3.16 Polarization microscope

c.1925, Fa. Ernst Leitz, Wetzlar
brass, 34 x 13 x 20 cm
Humboldt-University Berlin, Museum für Naturkunde
Inv.no. a/31

3.17 box with set of transparent cuts

1896, samples from the collection Moericke, modified by Ferdinand Wolf
1904
cardboard, glas, box 4 x 16 x 8
Humboldt-University Berlin, Museum für Naturkunde
no Inv.no.
The solar microscope was used as projection apparatus since the early 18th century. Sunlight caught in a mirror was directed through a lens to small objects on the holder. Another lens behind the objects transferred the picture to a screen. In the case of the Gesellschaft Naturforschender Freunde, a naturalists society founded in Berlin in 1773, the function of the apparatus however receded behind its historical symbolism. During the time of decreasing importance during the early 20th century, the society tried to evoke the old social grandeur by setting up a tradition table (Traditionstisch) at the Natural History Museum, where the society’s collection had found shelter. Among the society’s diary, the seals and charters, the solar microscope became the embodiment of gazing as social bond.

P. Harting, Das Mikroskop. Braunschweig: Vieweg 1866.
Outlook

Most of the objects on display in museums for the history of science are precious, complex, spectacular and beautiful. However, actual scientific practice involves every-day things with almost no monetary value, fast wearout and boring appearance. The geologist W. Brian Harland (1917-2003) decided to donate the full range of objects used for his scientific activities to a museum. Harland understood his tools and instruments as necessary associates of his scientific undertakings, namely his outstanding survey of Svalbard (formerly Spitsbergen). (fig. 4) The results of this survey just as the collection of instruments, was, as Harland explained it, partly the result from necessity. "Understanding depended on mapping the area geologically which entailed a simultaneous topographical survey. In effect this required plotting the position in space of geological features as observed and interpreted, often frequently telescopically until visited. ...The data are all thus potentially plotted on detailed and special purpose maps – one outcome was the topographical geological map. It was indeed the need to map that occasioned the need for instruments which is the purpose of the collection offered to the Whipple Museum." (Harland 2003, p. 1f.) What makes Harland’s material legacy an interesting manifest for today’s exhibition practice, is the sensibility of the donor recognizing his instruments as remains of past stages of a science, that could be navigated by the accidental, the unexpected, the unpredictable, and that was – together with its objects – in constant transition. „The collection of materials offered to the Whipple Museum have one thing in common. They have been accumulated for use by one person namely a geologist actively engaged in field work from the 1930’s. ...It is however the normal survey procedures that have changed beyond recognition so that the sample of instruments in this collection are all virtually obsolete...". (Ibid. p. 1 and p.3)

3.19 goggles
late 20th century, by Pulsafe
legacy of W. Brian Harland
plastic, 17 x 10 x 6 cm
University of Cambridge, Whipple Museum of the History of Science
Inv.no. Wh. 6117
On Scientific Objects and Their Visualization

Anke te Heesen

Scientific collections are getting a lot of attention these days. They have taken center stage at conferences, are the focus of scores of research projects, and crop up regularly in feuilletons. The spotlight was initially trained on early sixteenth- to eighteenth-century collections, which seemed particularly strange and intriguing. Today, however, even the most recent postwar collections are being rediscovered as subjects for study. The reasons for this veritable boom are manifold. Rapid developments in the (natural) sciences are doubtless one factor contributing to increased interest in historical artefacts from the history of science. Another reason is the ongoing digitalization of both written and visual documents, which inevitably leads to heightened awareness for material representations of knowledge from other eras.

These Objects of scientific materiality oscillate between their integration into teaching and research, on the one hand, and their increasing historicization on the other. For example, accepted practices in mineralogy still allow not only for the visual inspection of, but also for the touching and tasting of samples to acquire deeper knowledge about rocks and minerals. The instruction of anatomy, on the other hand, began a transition in pedagogical practice some time ago. The wet specimens and models of the past have gradually been replaced by two-dimensional digital images enhanced with 3-D effects. These have even come to be regarded as more helpful and precise than their predecessors. It should come as no surprise, then, that taxidermied birds are no longer merely in feuilletons. The spotlight was initially trained on early sixteenth- to eighteenth-century collections, which seemed particularly strange and intriguing. Today, however, even the most recent postwar collections are being rediscovered as subjects for study. The reasons for this veritable boom are manifold. Rapid developments in the (natural) sciences are doubtless one factor contributing to increased interest in historical artefacts from the history of science. Another reason is the ongoing digitalization of both written and visual documents, which inevitably leads to heightened awareness for material representations of knowledge from other eras.

Even a cursory glance at recent exhibitions reveals the productivity of the intersections of scientific collections and the history of science. While science museums have tended to consider themselves repositories for scientific and technical achievements, the last thirty years have witnessed the development of many new presentation formats. So-called “hands-on experiments,” for example, employ visitors’ direct participation in elucidating fundamental natural phenomena. The public is no longer understood merely as illustrative materials in standard first-semester university biology units on classification, but far more as witnesses to practices of earlier transmission of knowledge. They are being discovered as evidence for techniques of preparing animal specimens and, hence, for individuals’ and scientists’ notions and studies of nature.¹

Our ability to interpret the birds in this manner has much to do with recent currents in the history of science. These include investigating specifically scientific forms of knowledge, probing the role of experimentation, and interrogating the historical contextualization of science. Such developments have been decisively influenced not only by the aspects of materiality and scientific practice, but also by aesthetics. Accordingly, science loses its monolithic character and becomes corollary to other forms of expression less dependent on notions of objectivity for their legitimization. The borders between the two cultures have become more permeable. To return to the example of the taxidermied bird: How it is prepared, its pelt shaped and positioned, and the contexts in which it is exhibited allow us to read it alongside exhibited design objects or artworks from the corresponding era. A cultural-historical focus within the history of science has been the driving force behind these developments, and they form a strong foundation for a sophisticated treatment of scientific collections.² Conversely, it has also been recognized that scientific collections house extraordinary potential for researching historical practices and that insight into the development of knowledge depends to a large extent on the material objects themselves.³

Even a cursory glance at recent exhibitions reveals the productivity of the intersections of scientific collections and the history of science. While science museums have tended to consider themselves repositories for scientific and technical achievements, the last thirty years have witnessed the development of many new presentation formats. So-called “hands-on experiments,” for example, employ visitors’ direct participation in elucidating fundamental natural phenomena and universal laws of nature.⁴ Such experiments make science tangible. However, they do not encourage free, independent experimentation, but instead mimetically replicate absolute scientific principles. These interactive presentations use the object itself to spark the visi-

tor’s interest. The object’s significance is then gradually revealed through the visitor’s own participation. While the value of such approaches is debatable, it is nevertheless important to note that they introduced staged viewing and heuristic presentation techniques into the traditionally dull realm of scientific presentation. A second kind of exhibition stands in contrast to the hands-on approach, focusing instead on the history of a scientific topic and depicting science as but one link in a larger cultural chain. This approach structures exhibits around books and models, instruments and specimens, which – when taken together – yield a narrative of science that also encompasses the social and physical conditions of a discovery, its protagonists and their working conditions. Both styles differ greatly from the strategic placement of one instrument alongside the next. Curators instead present diverse objects culled from a wide variety of sources. By reciprocally shedding light on each other, they have the potential to capture the viewer’s imagination. A third and final kind of exhibition unambiguously aestheticizes scientific objects. This approach gives center stage to the technical dexterity necessary to produce scientific instruments. It emphasizes the material qualities of scientific objects and conceives of them as an art form. Most notably, the notion of the Kunst- und Wunderkammer [cabinet of art and curiosities], revived in the 1990s, came to refer to the objects’ intricate web of semantic meanings, staging their locus between art and science. In this manner, a form of collecting with Renaissance roots became emblematic of a multidisciplinary attainment of knowledge, which in turn is demonstrated by the materiality of the exhibited images and objects and is realized through the exhibition’s evocatively directed gaze; it is dependent, in short, on the correlation of both cultures, of art and science. The constellations of objects created in exhibition rooms thus facilitated the parallelization of previously incommensurable objects. This discourse, initiated primarily by art historians, again brought to the fore the significance of material culture in the creation of science exhibitions.

The common denominators in the developments I have sketched above are the objects themselves and their preparation – be it for technical applications [scientific collections], for use in historical knowledge [history of science], or for presentation in exhibition halls [museums and exhibitions]. As such, they become objects that transcend disciplinary boundaries and evince the material relativity of knowledge and cognition. Further, they testify to the fact that science is unthinkable without embodiment and reproduction. A number of recent publications that provide theoretical underpinings both for material culture and the concept of the object can be read against this backdrop. I would like to apply these discussions to scientific collections and will explore whether engaging with the material culture of science can give rise to more precise conceptual definitions. Three paradigmatic objects from the recent history of science will form the basis of this investigation.

Three terms rooted in the sociology of science and the history of science have informed recent studies of the production of objects of knowledge [in the natural sciences]. Susan Leigh Star’s and James E. Griesemer’s widely cited, canonical article about the multidisciplinary institutionalization of ecology was published in 1989. The authors examined the structures and conditions that enabled communication between the various disciplinary groups engaged in this process. Centering on the question of how a disciplinarily diverse network of collaborators can join forces in pursuit of a common goal, the study traces how the field of ecology was institutionalized. Star and Griesemer assert that this process necessitated two basic postulates which played a far greater role than the prior consensus of all involved parties. The first condition was common methodological approaches; the second, so-called “boundary objects.” Such objects are characterized by their pliancy and adaptability, which allow them to be implemented in a variety of disciplinary settings. Nevertheless, boundary objects must also be resilient and standardized enough to unify the divergent disciplinary discourses that have a stake in the project at hand. “Scientists and other actors contributing to science translate, negotiate, debate, triangulate and simplify in order to work together.” The study details the instruments and equipment requisite in facilitating the inevitable acts of translation and compromise that arise between the different professional interest groups involved. Star and Griesemer articulate four kinds of boundary objects: repositories [such as certain file or document formats]; defined ideal types [“species” in biology is one example]; coincident boundaries [for instance, when a geographically defined
boundary corresponds with that of a nation), and standardized forms [e.g., indexes in scholarly books]. It follows that boundary objects are fundamental negotiational agents, which – as in the case of repositories – can result in clearly defined artefacts that, in turn, can consist in standardized methods, such as citation methods. Crucial to boundary objects is the concept of an epistemologically generative flexibility and openness of the instruments, allowing them to adapt time and again both to material constraints and to the participants’ communicative needs. Here it becomes obvious how [three-dimensional] objects can be perceived as agents of communication, as media capable of bridging the disciplinary purlieus of various collaborators.

The sociologist of science Bruno Latour also investigates a similar nexus in the process underlying how laboratories and fieldwork generate scientific results. His work attempts to more clearly describe the relationships between participants in scientific processes. In a departure from traditional sociologists of science, Latour’s notion of participants in this process includes not only individuals – i.e., scientists or laypeople, technicians or administrative staff – but also laboratory instruments and equipment, the writing instruments brought along on an expedition, and ultimately the objects of study themselves. Latour describes this as a collective investigation, “of what holds with what, of who holds with whom, of who holds with what, of what holds with whom”. Like human beings, objects also possess their own discrete potential, which dissolves the boundary between the researching scientist and the instruments and materials he or she uses. In order to describe the compromises and exchanges between the various human and non-human actors at play in the scientific research process, Latour coined the term “immutable mobile”. He defines immutable mobiles as inscriptions or “transformations through with an entity becomes materialized into a sign, an archive, a document, a piece of paper, a trace. Usually but not always inscriptions are two-dimensional, superimposable, and combinable. They are always mobile, that is, they allow new translations and articulations while keeping some types of relations intact”. Latour’s mobiles are also informed by the sociological question as to the establishment and communicability of congruities, which can later be described as scientific facts. For him, too, the translatability of representations generated by scientists is key. However, he simultaneously emphasizes the mobility of the produced inscriptions and thus also the mobiles’ dissemination.

Star and Griesemer address the smallest common denominator and hence make a boundary of sorts within their “boundary objects” the true focus of these conglomerates of objects. Latour emphasizes “mobiles’” capacity for manageability, mobility, and connectivity. The historian of science Hans-Jörg Rheinberger has yet another approach, directing his attention to the materiality of inscriptive processes in laboratories or other centers of research. He calls objects encountered in such settings “epistemic things,” defining them as ephemeral manifestations of a question or thought process: “They are material entities or processes – physical structures, chemical reactions, biological functions – that constitute the object of inquiry.” He speaks of “sedimentations of local and disciplinary working traditions” and aims to write a “history of objectivity” deciphered from “material traces”. Objects that reference the communication between scientists are less at issue in this approach; instead, it is interested in new, previously undiscovered objects resulting from the research process. When contextualized within a material system of reciprocal authentication, these objects are discoveries. Common to all three definitions is the attempt to describe an object’s substantiation, a [re]presentation consisting – at least initially – of nothing more than questions, rough notes, conjectures, and traces. Its structure emerges only over time, and the loose ends coalesce in this process of substantiation to become – as in Rheinberger’s example – a particular molecule, known in contemporary molecular biology as transfer RNA. Our level of knowledge to some extent determines the associations that come to mind when we think of this molecule. For some, it is a simple chemical structure; for others, it is a substance that transfers amino acids from cytoplasm to ribosomes, thus translating the genetic code into proteins. Transfer RNA is a black box of sorts for us today. Rheinberger investigates its genesis and, hence, its processual quality and its becoming. “It is my contention, therefore, that epistemic things – things

12 Latour 2000 as in fn. 11: 172.
embracing concepts – deserve as much attention as generations of historians have bestowed on disembodied ideas.\textsuperscript{17}

Whether epistemic thing – an intricate, often humble material and conceptual conglomerate that coalesces into a web of delicate traces – or whether immutable mobile – small, mercurial entities that are nevertheless impervious and resilient: In both cases, a narrative is constructed to explain how complex scientific entities come into being. In this way, scientific research has brought to light paradigmatic objects that exist in the past as well as in the present. Such narratives hinge primarily on a concept of scientific practice in which an object reveals or conceals itself, becomes a sensation or remains unobserved. This notion of objects works with malleable entities capable of demonstrating just how multifarious the web of disciplinary, cultural, or social attributes is in which the generation of knowledge occurs. Such objects are materializations that embrace both the researcher’s work and the object’s ultimate manifestation.

While Rheinberger’s model refers to novel, unforeseeable fruits of laboratory work that gradually coalesce and are identified, the other two models focus on the objects’ functionality and, hence, on their potential as facilitative objects. If we keep in mind that motion, not stasis, is the hallmark of these paradigmatic objects, it quickly becomes apparent that museum objects cannot readily be counted among their ranks. For museum objects have been pulled from their restlessness or, to cite Krzysztof Pomian, have been removed from their knowledge-generating circulation and rendered static.\textsuperscript{18} It follows that the aforementioned dynamic concepts cannot simply be imported point for point into museums and curated exhibitions. Not every object is an epistemic thing simply because something can be learned from it. The reverse also holds true: Scientific objects are not always delimitable, three-dimensional entities to be materially and visually identified. Rather, theoretical observations about the epistemological essence of things turns intriguing when we attempt in presentations to reilluminate the past journeys of objects that arise, for example, from experimental contexts. In this manner, exhibitions have the power to recover the scientific objects’ singular historical moments. Herein lies the fascinating potential that objects can hold for us today – and this is by no means restricted solely to objects from the natural sciences. This potential raises new questions regarding representability. The goal is to use objects as catalysts in shedding light on past practices, still discernible in traces. The dynamics of scientific practice can be rendered only in small steps and gradual manifestations, which at some point amount to new subdisciplines [ecology], new forms of soil mapping [soil sampling], and new building blocks of life [transfer RNA]. Scores of scientific collections at universities and research institutes house the material that documents these processes. Such collections walk the line between museal objecthood and continuing practical application in research and teaching. Some of the objects still find themselves in a tug-of-war between research and representation; others [probably the lion’s share] were removed long ago from their restless circulation. It is precisely this simultaneity of various meanings, temporalities, and levels of flux that dictates one of the most important potentials of scientific collections: These collections challenge us to articulate objects’ historical significance and impel us to carefully consider how we attend to science’s material manifestations.

\textit{Translated by Alys X. George}

\textsuperscript{17} Ibid. 8.

“The Very Pelvis of the World”: Science and the Pursuit of Whales

D. Graham Burnett

Introduction

We have an abundant and valuable literature on the history of whaling, but few works that approach whales historically as problems of scientific knowledge. How does one “know” the whale? This is not a small problem. “It is a ponderous task,” wrote that most poetic nineteenth-century commentator on cetology, Herman Melville, “to grope down into the bottom of the sea after them; to have one’s hands among the unspeakable foundations, ribs, and very pelvis of the world; this is a fearful thing.”

Taxonomically ambiguous, economically vital, physically imposing, these denizens of earth’s most recalcitrant environment have long symbolized both the power and the mystery of nature. Indeed, in the Judeo-Christian tradition the whale-monster actually embodies “the unknowable” itself: Yahweh’s answer to Job out of the whirlwind culminates in an apocalyptic invocation of Leviathan.

Do human beings understand this beast? Is it tractable to their desires? Will it yield to their inquiries? Job cannot answer. And that silence can be understood to have installed these hulking sea creatures in a most peculiar and dramatic place in the animal economy: the whale lives as the primordial rebuke to human yearnings to understand, as nothing less than God’s own trump card in matters of theodicy. No wonder, then, that Melville saw whale-knowledge as tinctured with the crimson stain of sin – an impious taint attached to all matters cetological.

The “very pelvis of the world,” he suggested. What a strange notion, not least in the case of an animal that is, for all intents and purposes, without a pelvis. Is Melville trying to tell us something? It is a worrisome possibility. One that becomes all the more distressing when we consider the figure that performed, in Melville’s time, the gargantuan dissection. Who exactly was it who was groping about in the bodies of these beasts? The author of Moby-Dick offers a thoroughly diabolical answer: In a brief chapter entitled “The Cassock,” Melville describes the investiture of the “mincer,” the sailor assigned to the task of carving the vast slabs of blubber into “bible leaves,” manageable-sized folios of fat configured into sheets still bound by their skin. Envision this dark priest, attendant on the huge smoking kettles, illuminated by the flame from fires stoked with crackle bits from the pots. What does the mincer wear while performing his stygian task? A poncho of waterproof leather, peak-hooded, and freshly flayed from a very personal and private part of the sperm whale himself. I’ll let Melville explain: “Arrayed in decent black; occupying a conspicuous pulpit; intent on bible leaves; what a candidate for an archbishoprick, what a lad for a Pope were this mincer!”

For Melville, as for many others of his time, there was something frankly satanic about cetaceans and those who attended on them.

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1. Department of History, Program in History of Science, Princeton University, Princeton, NJ 08544
Those of us who take an interest in whales are, it seems, forever pulled back into the orbit of this hulking book that looms in the middle of nineteenth-century American literature. I am reminded of a terribly funny passage in Joseph Heller’s *Catch-22* [we are attending on the progressive decay of a dying officer during World War II]:

> The colonel dwelt in a vortex of specialists who were still specializing in trying to determine what was troubling him. They hurled lights in his eyes to see if he could see, rammed needles into nerves to hear if he could feel. There was a urologist for his urine, a lymphologist for his lymph, an endocrinologist for his endocrines, and psychologist for his psyche, a dermatologist for his derma; there was a pathologist for his pathos, a cystologist for his cysts, and a bald and pedantic cetologist from the zoology department at Harvard who had been shanghaied ruthlessly into the Medical Corps by a faulty anode in an I.B.M. Machine and spent his sessions with the dying colonel trying to discuss *Moby-Dick* with him.

It must have been a faulty anode indeed, since bald and pedantic cetologists were in fact much in demand during the second world war: instead of offering ineffectual bedside “consolations of cetology” to dying officers in Italy, the best whale scientists were in fact drafted into the service of the U.S. Navy, where they had access to powerful new technologies for listening to the deep sea, technologies that were being used to prosecute an increasingly sophisticated submarine warfare. Out of this work on marine bioacoustics would come important new ideas about whales in the second half of the twentieth century.

Which returns us to the larger significance of *Moby-Dick* to the history of science: Once conceived as Miltonic monsters (à la Melville), whales were strikingly re-imagined over the course of the 1960s and 1970s, becoming for many not soulless, mindless beasts (or mere barrels of commodity oils), but rather soulful, musical kin to humanity, peace-loving symbols of human environmental irresponsibility, and even avatars of the Age of Aquarius. Marine bioacoustics and several other post-war sciences were at the center of these developments, though the cetologists at those Navy listening stations in the Pacific in the 1940s could never have guessed where their work would lead over the span of three short decades: For instance, in August of 1970 a 48-foot floating soundstage dubbed the *D’Sonoqua* pushed off from the docks of Vancouver carrying a car-go of folk musicians intent on performing a live concert for free-swimming small cetaceans in the bay; it was the first of many similar festival efforts at counter-culture interspecies “contact.” By 1975 *Greenpeace*, led by an apostate whale scientist outfitted with hydrophones, were disseminating dramatic footage of activists throwing themselves in front of Soviet harpoons in the Pacific. And by 1976, as NASA prepared to send humpback whale phonation into outer space on a phonograph disk of gold aboard Voyager I and II, Gilbert Grosvenor, the president of the (very mainstream) National Geographic Society, could declare that “the whale has become a way of thinking about our planet and its creatures.”

By this point cetaceans had become nothing less than familiar spirits, capable of mobilizing sentiment and action, capable of representing complex and culturally significant assemblages of aspiration and belief.

This has to be accounted one of the very largest transformations in modern human-animal relations, and the role of whale science in this development merits close attention. I am most of the way through a long and detailed book that deals with these issues, and they are difficult to summarize concisely. Perhaps, rather than try to résumé several years of archival work, I will instead offer, on the occasion of this striking exhibit at the Max Planck, a single window onto the problem, one that opens a valuable prospect onto the world of whale science at a critical juncture: From the 15th to the 18th of April of 1963 about seventy invited scientists from around the world gathered in the “John Glenn Suite” of the Marriott Motor Hotel at Key Bridge, in Washington D.C., for what was to be the “First International Symposium on Cetacean Research.” This event, which gave rise to a landmark publication in the field, offers a unique opportunity to understand the diverse and circuitous ways that whales had become objects of scientific inquiry in the twentieth century.4 I propose, then, for the remainder of this brief essay, to sketch out the different sorts of scientists who attended this event, and the different sorts of science they did. Along the way it will be possible to catch glimpses of the fault-lines and unlikely alliances that ultimately gave shape not simply to the science of cetaceans, but also, to a considerable extent, to popular imaginings of these creatures in a critical decade.

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4. The publication in question was: K. Norris, ed., *Whales Dolphins and Porpoises* (Berkeley: University of California Press, 1986). The treatment of the Symposium that follows is derived from a detailed chapter (“The Great Whale Circus”) of my forthcoming book on twentieth-century whale science. A fully referenced version of this material, and a sense of the archives out of which I have reconstructed this story, can be found there.
The Cetologists Convene

From the outset of the conference, a question floated in the room: Did this disparate group of invited specialists actually have anything in common? They had come from Norway, Japan, and Australia; from government fisheries bureaus, medical imaging laboratories, aerospace contractors, the Naval Ordnance Testing Station in the Mojave desert, from commercial animal training facilities, and military labs specializing in signal processing. They would be giving and listening to talks ranging from a discussion of the Antarctic distribution of the Pigmy Blue Whale, to reproductive morphology of the odontocetes [toothed whales], to presentations on human “whistle languages” in the Pyrenees. Reviewing the program, a historian might fairly ask, What’s the common ground here?

Convening this extravagantly diverse crowd, the chairman of the first session, the Cambridge-trained Scientific Director of the Zoological Society of London, L. Harrison Matthews, addressed this issue explicitly: What, in Matthews’ view, did the group really share? His answer was two-fold: A distinctive object of inquiry, and a distinctive esprit de corps. As he put it:

The Cetacea differ so widely in all respects of their biology from the other mammals that cetology has evolved into a specialized branch of zoology. Cetologists too, seem to be a race apart from other zoologists. If they are anatomists, they are undismayed by the task of dissecting a hundred tons of highly flavored carrion...If they are ethologists, their laboratories are huge oceanariums where they don aqualungs in order to join the objects of their study in a foreign medium.

In the pursuit of these “most interesting and elusive animals” cetologists had to be resourceful, intrepid, even, Matthews suggested, “incurably romantic.” What L. Harrison Matthews offered to the room, then, was nothing less than an invocation of their collective identity, a new scientific persona marinated in ocean spray and in the salt sweat of exotic fieldwork with big, strange animals. With this convocation in mind, let me turn to my exercise in classification. I want to suggest that Matthew’s “race” of cetologists, is best understood as the product of cross breeding among what we might think of as three distinct scientific “subspecies”: 1) what I’m going to call “hip-boot” cetologists; 2) experts in bioacoustics; 3) medical doctors and psychologists and students of animal behavior all of whom were interested in cetacean intelligence. This is a very schematic breakdown, but it is adequate for our purposes. In the pages that follow I will say a bit more about each of these groups, focusing on how each of them approached cetaceans as objects of scientific investigation.

First, the “hip boot” types. These men – including, for instance, L. Harrison Matthews himself – can be thought of as the old-guard. Matthews and two other senior scientists in attendance at the symposium could boast of having been participants in the earliest and most significant dedicated research expedition to study cetaceans: the British “Discovery Investigations.” These began in the early 1920s as a series of voyages into the Antarctic whaling grounds to gather information about the commercial species that had come under massive exploitation pressures in the early twentieth century, for use as human food [margarine] and soap. Discovery’s deep-pocketed research program, administered through the British Colonial Office and funded by a tax on whale oil, ran all the way through the late 1940s, yielding to the world a thick shelf of technical monographs on whales and related oceanographic problems. Without question it was the main training ground for English whale scientists in the first half of the twentieth century, and it probably represented the most concentrated reservoir of whale-knowledge in the world at the time.

What did this mean? Well, each of these men had spent months [in some cases years] standing knee-deep in the guts of the whales of the southern ocean, conducting dissections on carcasses en route to the rendering ovens of shore whaling stations. (fig. 1)

Figure 1: Dante in the Antarctic: The shore station at Grytviken, in South Georgia; from a watercolor by Alister Hardy, one of the original “Discovery” scientists. Alister Hardy, Great Waters (New York: Harper and Row, 1967), following page 160.
This was an immensely trying environment in which to conduct scientific research, indeed, these were arguably among the most horrible places on earth: the stench of the charnel house, the freezing work on steaming cutting platforms slick with blood, fat, and fecal matter. As one of the scientists put it, "the physical work involves excavating the genitalia from a huge mass of viscera and cutting notches in the vertebrae with an axe." After the early 1930s most of this work moved from the shore stations [which had ceased to be commercially viable] to the new factory ships, where, if anything, the task of the researcher was even more dangerous and unpleasant. (fig. 2)

There is a great deal to say about this sort of research, which involved an extensive tagging program, as well as pioneering life historical investigations, but for our purposes I simply want to emphasize that "Discovery style" whale science had been replicated in a variety of other national contexts. The Japanese had their Whales Research Institute, the Norwegians and the Dutch likewise had extensive programs of this kind. In all, there were about twenty such scientists in attendance at the Symposium in Washington.

Let’s turn to the second group: the bioacoustics types. Here we are in an enormously different world: the world of military contractors and cold-war conflict. Submarine warfare radically changed naval combat in the 1940s, and yielded new technologies for probing the deep. Historians of modern science are accustomed to consider physical oceanography as the primary beneficiary of all this, but the life sciences too received a considerable dividend. As Susan Schlee put it in her 1973 history of the ocean sciences, *The Edge of an Unfamiliar World*, "within the first six months of the war, American submariners anxiously reported hearing staccato taps, clanks, rumblings...and, most eerie of all, the rhythmic beat of sonarlike beeps and pings." A fair portion of those sounds, it would turn out, were being made by whales, dolphins, and porpoises. This meant that in the 1950s and 1960s, dozens of researchers at Scripps, Woods Hole, Lerner Labs, and elsewhere, were at work on the collective task of recording, identifying, and cataloguing cetacean sounds. A preponderance of this work, of course, was classified, but portions of it came into the public domain.

An example of the latter is "Whale and Porpoise Voices," prepared at Woods Hole in 1962 by two experts in cetacean sounds whose technical formation lay in Anti-Submarine Warfare. This pamphlet contained identification information on dozens of cetaceans, showing not only a picture of the animal in question, but also a portion of the sound spectrograph for its phonation. (fig. 3)

An accompanying phonograph recording of these sounds was released the same year. By the early 1960s information like this had already been in use for the training of SONAR technicians for years, but it was just beginning to be made available to civilian scientists without security clearances.

Simply recording, plotting, and identifying cetacean sounds was thus a significant part of Navy bioacoustics work in the 1950s and 60s, but the astonishing discovery in the mid 1950s that many toothed whales had their own “sonar” systems – that they could “see” with sound, and could do so much better than available technology – opened a vast new area for research. So, for instance, several of the participants at the First International Symposium on Cetacean Research had been involved in an elaborate series of experiments conducted in 1961-62 to substantiate a hypothesis that interpreted the morphology of the skull and soft tissue in the head of smaller odontocetes by means of an extended analogy to a sophisticated directional transducer and acoustic lens. (fig. 4) Efforts to confirm this hypothesis experimentally were inconclusive as of 1963, but work continued.

Again, there is a great deal more that might be said about the bioacoustics types in attendance at the Symposium – about three dozen of them were there, mostly Americans, and essentially all were involved in Navy research in one way or another. Nevertheless, we need to move on to consider the third and final group – the clique at work on animal communication, on the mind and behavior of the small whales.

If this was the youngest and smallest group, it was also the most controversial and, we might say, exotic. It was not merely that the premier of Flipper at the start of the summer had made communicating with dolphins a national sensation (though this was certainly part of it); the real reason for the buzz that followed researchers in this area must be attributed to the combative and proselytic zeal of their most prominent practitioner, John C. Lilly. (fig. 5) Lilly, a high-flying neurophysiologist who had recently won an NSF Career grant for his work on dolphin brains, was, without question, the only participant in the Symposium who could plausibly be described as a household name. Not only had he published a popular book on “intelligent dolphins” and helped inspire the story of Flipper (on which he received a credit), his research had also drawn the attention of the great nuclear physicist Leo Szilard, who had immortalized Lilly in a Cold War parable of nuclear disarmament entitled The Voice of the Dolphins.

Out of the dozen or so researchers at the conference who worked on one or another aspect of dolphin “language,” about half were in his unofficial “delegation” and worked for him at his dedicated dolphin laboratories in Miami and the US Virgin Islands – including, for instance, the respected ethologist-cum-anthropologist Gregory Bateson.

Given Lilly’s prominence, then, I will focus on his personal trajectory for a moment, in order to convey a general sense of this third category of cetacean research. Lilly, an MD, trained in cortical mapping at the National Institutes of Mental Health in the 1950s, working to plot the regions of the brain associated with different affective states – pain, fear, pleasure, etc. Drawn to the comparatively large brains of cetaceans, he and several collaborators made visits to Florida in the late 50s, to the aquarium known as Marine Studios, to conduct neurophysiological examinations of living dolphins: doing very much the same thing that he was accustomed to do with macaques – hammering electrodes through the skull, running current into different parts of the brain, watching what happened.

It was in the course of this work that Lilly came to believe three things: that dolphins were much more intelligent than primates; that they had an elaborate language they used among themselves; and that they were
trying to communicate with their human handlers. Beginning in the early 1960s Lilly wrote of these “discoveries” in grandly world-historical terms, situating himself at the cusp of the fourth “great displacement” in the history of science: citing Freud’s classic formulation, Lilly explained that man had, over five hundred years, been thrust from the center of the universe (by Copernicus), from the center of organic nature (by Darwin), and finally from the center of his own mind (by Freud); but *homo sapiens* still preened itself as the only intelligent being on earth. Overthrowing this, Lilly believed, would be his great legacy.

It was on the positive reception of this early work that Lilly received the funding (from ONR, NSF, and NASA) that permitted him to leave NIMH and set up his own labs (The Communication Research Institute), dedicated to research on dolphin communication – both with each other, and with human beings. As he hired a slate of skilled researchers and pursued technical publications to substantiate his radical claims, an expanding group of scientists in animal behavior, linguistics and neuroscience – a number of whom were at work with the Navy – began trying to reproduce his results.

Again, I’m going to have to drop a very rich topic that I have just barely opened. But I want, now, to leave off with this elaboration of my three-part taxonomy of cetacean science, and turn in closing to a brief discussion of what happened when these different kinds of scientists – hip-boot whale biologists, Navy bioacoustics experts, and a visionary contingent of researchers probing the cognitive life of the small toothed whales – found themselves in the same room. Did they have anything to learn from each other?

That these groups had diverse and divergent interests should be clear. For instance, consider their very different wish lists for new research platforms. The hip-boot cetologists wanted a scientific whaling ship. What whale-science needed, in their view, was a Maecenas willing to bankroll a factory vessel manned by and run for whale scientists, allowing them to go anywhere in the world to harpoon and dissect unusual species. Needless to say, such an arrangement would have been the veritable apotheosis of the *Discovery* Investigations out of which these men came. But the scheme (never realized) had precious little appeal for the scientists interested in the phonations and behavior of the smaller cetaceans. They hacker instead after a platform for study of the live creatures in the wild as they barked and chirped. A few years later they would get their wish, in the unique Sea See research vessel built for the Naval Undersea Center – a boat that had a kind of “ball turret” that hung under the deck and permitted a scientist to “swim” with small cetaceans that accompanied the vessel or rode in the bow wake.

At the same time, there were intersections among what I have set up as these three “tribes.” For instance, whaling vessels had for some number of years made use of sonar systems; while these never really worked to spot whales, whalers discovered that sounds at the right frequency could be used to drive and herd the animals. Hip-boot cetologists might therefore stand to learn useful things from the bioacoustics types about hearing ranges and call patterns. The exchange went both ways. If we go back to the “bionic” interpretation of the head morphology of odontocetes, we can recall that the whole hypothesis depended on the point-source of sound production lying in vestibular sacs of the upper airways. Unfortunately, the hip-booted anatomists thought this was immensely unlikely, giving rise to a host of jabs and parries over the course of the symposium: for the anatomists, the lower larynx was the only organ configured for sound production. When a former ASW researcher suggested that sperm whales might use focused sonar “blasts” to stun their prey or jam the signals of other sea creatures, one of the hip-booted cetologists rose to object, pointing out that the air sacs supposedly making the sounds were large enough to “admit three men lying down”; there was no way they could produce the high frequencies at issue. It was the objection of someone who had groped down inside a whale, and not just looked at the output of an oscilloscope.

Where the students of cetacean language and intelligence were concerned, the conflicts were even more pronounced. Lilly had gone so far as to suggest, only partly in jest, that invasive research on dolphins would
need to hurry up, before the animals got wise to humans, and began to complain. For a gruff hip-boot type, who had felt around in the guts of more than a thousand cetaceans, Lilly’s whole program seemed insane. Wrote a former Discovery scientist in his notes after listening to Lilly: “several speakers on...intelligence and behavior seem not to be clear on what they are really trying to discover, or the validity of methods.” Another hip-booter would later muse grimly that, where American research was concerned, the “bottlenose dolphin had become the prima donna of the cetacean fraternity.”

There was, in fact, a sharp anti-Lilly irruption on the last day of the symposium that speaks volumes about the changing character of cetology in these years. In fact, the aftershocks of this confrontation revealed a widening fissure in the nascent community of whale scientists: a fault line that cracked not along research interests or training – the sorts of things with which I have been primarily concerned in my taxonomy – but rather along the grinding plates of an emerging tectonic cultural shift, moved by the pressures of war and peace.

Here is what happened: on the final day, in a discussion of the very last paper, there was a mention of Lilly’s recent article in Science on the “distress calls” of the bottlenose dolphin. At this point, according to a letter by a participant written shortly after the event, one of the Navy scientists jumped up and declared that Lilly had faked his results in this area. Something of a shouting match got going, and a few snide remarks about the direction of Lilly’s work brought a burst of derisive laughter.

The identity of the attacker can be recovered: he was Forrest G. Wood, formerly director of Marine Studios in Florida, and an early Lilly collaborator. But they had since gone their separate ways. Just two months before the symposium Wood had accepted a new post, as co-director of a just opened dedicated Navy center for the study of whales and dolphins: the “Cetacean Research Facility” at the Naval Missile Center at Point Mugu, near San Diego. Wood, who had come to despise Lilly’s grandstanding, wanted to make this new center a “clearing house” for cetacean research around the world, and he and his assistants handed out information packets at the symposium, offering to serve as the hub for queries and bibliography from participants.

In the wake of symposium, Lilly went on the warpath, writing to his friends and supporters of Wood’s venom, and urging them to disregard what he saw as an attempted coup in the field; he complained passionately that the Navy’s new personnel were trying to squeeze him and his Communication Research Institute out of future research. And he was right. Despite Lilly’s own links to the military [and there is much to say there, since he had indeed stimulated Navy interest in smart dolphins], a consensus was forming within the Navy establishment that dolphin work was important, but that Lilly was a loose cannon.

In the last hour of the First International Symposium on Cetacean Research, then, it is possible to sense the first tremors of the kind of conflict that would help make whales and dolphins the charged creatures of the counterculture in the decade to come: The Navy research program would shortly embark on a successful effort to train dolphins to work beside Navy frogmen in the open sea, a program that would lead, ultimately, to the deployment of dolphin “watchdogs” to defend naval ammunition depots in Vietnam at Cam Rahn Bay. Lilly, notoriously, went a very different direction: increasingly drawn to the mind opening power of psychopharmaceuticals, Lilly began to make more and more fantastic claims for his work: beginning in 1965 he would argue that he had broken through the species barrier and communicated with these “extra-terrestrial” inhabitants of our oceanic “inner space,” who, he would later suggest, were nothing less than sexual sages and the genies of spiritual freedom. Defrocked by the system of peer review, Lilly drew around him a coterie of likeminded believers, becoming a kind of guru-prophet, vilified by his former colleagues.

This widening division between cold war whales and the age of Aquarius could blind us to the pervasive entanglements: not only did Lilly’s original speculations about cetacean intelligence significantly spark the emergence of the Navy’s Marine Mammal Program, but Lilly’s ad-dled vision of the dolphin as an extraterrestrial must be understood as nothing less than a illegitimate offspring of the Navy’s own efforts, in the era of the space race, to present the seas as the “other final frontier.”

Finally, while modern marine mammal biologists are at pains to dismiss Lilly as a notorious charlatan, it is instructive to push past this antipathy, and to reveal his more subtle legacy; for instance, it was a former intern in Lilly’s communication laboratory who, after Lilly’s fall from grace, set to work on recordings made at a naval station in the Caribbean of particularly crazy whale phonation. Using the same very techniques of phonemic analysis he had learned parsing “dolphin talk” for Lilly, that researcher, Scott McVay, “discovered” the “songs of the Humpback whale,” a series of haunting and repetitive tones that would become a platinum album, and a sensational rally call for the Save the Whale movement.

With that strange braid of Navy bioacoustics, Lilly-spirited listening, and the unmaking of the hip-booted industry, let me bring this essay to a close and offer a few general thoughts.
Conclusion

We are rightly accustomed to perceiving the activity of scientific inquiry as, in significant part, a process of de-mythologization. In Bruno Latour’s terms, it is the hammer of critical rationality – the tool of scientific modernity – that strikes the unfortunate fetishes of myth, those totems brought forward by benighted pre-moderns and their mere belief. In this iconoclastic blow, the accretions of myth, belief, and legend fall away, revealed to be merely artifacts of human collective fantasy and mythopoiesis. The really-real, the facts about things, these remain, since they are impervious and durable. What stands where scientists have passed, then, is nature, just nature, without anthropocentric frippery, spiritual corsage, or the frogging and furbelows of human fear and desire. But as Latour and others have recently been much at pains to show, gestures of iconoclasm have unpredictable effects: not infrequently they rebound sideways, revealing, for instance, that the iconoclast himself may have even deeper commitments to the fetish he assails than did the putatively-deceived in whose midst it stood, and in the name of whose liberation the iconoclast has struck (after all, the iconoclast without icons is a lonely figure); indeed, shattered icons have a strange way of turning back up – lovingly preserved, carefully re-worked, and finally elevated to central pedestals in the temples of the iconoclasts.

The story of cetology and the whale is fascinating precisely because it represents a striking and significant instance of this unstable relationship between icons and iconoclasm, between science-doing and myth-making. Few disciplines can more straight-forwardly tell their story as one of gradual demystification: once whales were the great unknown – monsters of the deep, Leviathan, known only to God Himself. Gradually, the wild legends, the seafarers’ yarns, the biblical tales, all gave way – fell away – as men of learning pursued the cetaceans with harpoons, microphones, nets, and neurological probes, leaving a pile of quaint old beliefs in shards (on the one hand), and a proper knowledge of what cetaceans really were (on the other).

And yet, somehow, in the process, what emerged was a new creature of extraordinary symbolic power, whose looming significance swelled with each seemingly deflationary blow, whose new iconography was composed, rapidly, mosaic-like, out of the broken bits of the old myths (so Navy dolphins were being trained to help sailors, as in the ancient tale of Arion...), heightened with bright shards borrowed from the workshops of scientific cetology (so the whale-hugger-saboteurs releasing Navy dolphins back into the wild could believe that the animals “saw” the fear and good will of their liberators by sonar-scanning their racing hearts...). It was this puzzling, run-away process that the distinguished professor of linguistics, Thomas Sebeock, glimpsed in Lilly’s call to arms, Man and Dolphin, of 1961: “Like Blake’s Tiger, Lilly’s Dolphin is at once something less and something more than man, a visionary creature, symbol as well as thing. With this figure in a double narrative, on the level of science and on the level of myth, he has written a strange, irritating, anecdotal, and provoking book.”

Lilly, of course, would be ruled – despite his protests – simply a poor iconoclast and a scientist-gone-bad. He could [and would] be placed, retrospectively, in the category of the myth-makers, not the cetologists. But as the symbolic significance of whales and dolphins continued to swell, and as the elaborations of that significance became more baroque and versicolor, whale science itself could not but benefit from, and trade on, the ever-more glorified status of its beasts. In the process, cetology did indeed rebound in some unpredictable ways: hip-booted cetologists with a hand in the whaling industry might complain about the fuss, but, at the same time, they were emerging as the keepers of a newly sacred flame, and a number of them answered the call, publishing prettified books that fed public fascination even as the authors postured to retain their credentials as objective men of science, consigning the myths of yore to oblivion as ever (though rehearsing them, custodially, for collective edification). Other figures, like Roger Payne, managed, more successfully than Lilly, to become gurus of whale-hugging [and to take international cetacean enthusiasms to the wide screen] while retaining their scientific personae.

All this may seem strange. As Sebeock would put it, “strange, irritating, anecdotal, and provoking.” But it is strange and provoking – the history of cetology and the whale in general is, I would argue, strange and provoking – precisely because it brings to the surface a lurking problem that is too easily left submerged when we trace the progress of knowledge-making, a problem that is, in the end, central to the history of science: How is it that human investigations of the natural world continuously wipe away the all-too-human fingerprints on the mirror of nature, and in doing so perpetually offer us captivating ways to see ourselves anew?

In the surface of the sea, in Lilly’s dolphins, in what Melville calls “the awful Chaldee of the Sperm Whale’s brow,” we catch such beguiling reflections.
The plant self impressions prepared by Humboldt and Bonpland in tropical America

H. Walter Lack

Introduction

For good reason W. T. Stearn wrote 'The expedition to South and Central America in the years 1799 to 1804 by Friedrich Heinrich Alexander von Humboldt [1768-1859] and Aimé Jacques Alexandre Goujaud Bonpland [1773-1858] has long been accepted as the most important made to America, because its results, based upon study by many specialists of the immense quantity of specimens and observations relating to botany, zoology, geology, geography and history which they amassed with almost incredible industry and often under great difficulty, were ... made available within a comparatively short period afterwards in a series of comprehensive and well-illustrated publications, together forming the Voyage aux Régions Équinoxiales du Nouveau Continent'.

As a consequence the literature on this expedition is vast, scattered among numerous publications and constantly growing. Since many plant names have been based on specimens collected by Humboldt and Bonpland and validated in the work cited above, the botanical part of this project has been studied with particular attention and in exceptional detail by a long series of researchers.

Herbarium specimens, fruits, seeds, field notes and rough sketches form the hard core of the botanical materials brought back from South and Central America. They were supplemented by many letters sent to various correspondents and often intended for immediate publication. Surprisingly Humboldt and Bonpland also produced a series of plant self impressions on their expedition. Although mentioned briefly in the description of the Musée Botanique owned by Jules Paul Benjamin Stearn,

Baron Delessert (1773-1847) in Paris, these prints remained virtually unknown to the scientific community and seem to have been totally ignored by researchers studying the ‘Voyage’.

The bound volume containing these materials was recently put twice on show in Paris – in 1993 in the famous Bibliothèque Nationale at an exhibition entitled ‘Botanica in originali. Livres de botanique réalisés en impression naturelle du XVIe au XXe siècles’ and in 2001 in the equally famous library of the Institut de France at an exhibition dedicated to the life, work and collections of Delessert. The first exhibition was accompanied by a printed catalogue, the second by a photocopied hand-list.

In both texts the entry on the plant self impressions prepared by Humboldt and Bonpland is so very short and inadequate, that a more detailed analysis seems appropriate.

Humboldt’s worries

Like most collectors Humboldt was deeply worried about the preservation of his botanical collections and their safe transport home. Several references to this problem are to be found in his letters written en route. For example, on 21 February 1801 Humboldt reported from Havana to his botanical mentor Carl Ludwig Willdenow (1765-1812), apothecary and professor at the Collegium medico-chirurgicum in Berlin: “But, alas almost in tears we open our plant boxes. Our herbaria have the same fate lamented already by Sparman, Banks, Swartz and Jacquin. The immense wetness of the American climate, the rankness of the vegetation, which makes it difficult to find fully grown leaves, have

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3 Lasègue, A., Musée botanique de M. Benjamin Delessert. – Paris 1845: Librairie de Forbin, Masson.
destroyed one third of our collection. Every day we find new insects which destroy paper and plants. Camphor, turpentine, tar, pitched boards, hanging boxes fixed on ropes in the open, all tricks devised in Europe fail here, and our patience has become tired. After being absent for 3-4 months you hardly recognise your herbarium, you have to discard 5 out of 8 specimens.\textsuperscript{6} Bonpland may well have felt similarly, but no attempt is made here to analyse his letters written in the Americas.

Looking out for a way of documenting their plant collections, Humboldt and Bonpland found nature self impression a suitable method: pressed plant specimens were stained with printers’ ink, used as printing forms and pressed on paper. This approach resulted in rather crude images, but had the advantage of producing records which were not attacked by insects.

Surprisingly Humboldt nowhere refers to his plant self impressions – neither in his very many letters sent home from his travels,\textsuperscript{7} nor in the ‘Voyage’ itself or in his much later opus magnum ‘Kosmos’.\textsuperscript{8}

The plant self impressions

The library of the Institut de France in Paris preserves as MS 998 a manuscript measuring c. 31.5 x 24 cm. It comprises 252 leaves of paper and is marked on the title-page ‘Impressions de Plantes du Voyage de MM. Humboldt et Bonpland Donné par M. Kunth le 26 Juin 1829’ [Plant impressions from the voyage of Mr. Humboldt and Mr. Bonpland donated by Mr. Kunth on 26 June 1829].

The rather thin paper merits special attention: with the exception of the blue leaves f. 43-54 it is white and often shows watermarks clearly indicative of a Spanish mill – e. g. two crossed ‘Plus outre’ – columns and a crown very similar to that found today in the coat of arms of the Kingdom of Spain (f. 169), the note ‘Ramon’ (f. 78) or ‘Bernardo’ (f. 196).

The plant impressions are in solid black and found often both on recto and verso of the pages. In several cases the tinted and pressed plant specimen was put between two pages forming part of a single sheet, e.


\textsuperscript{7} Moheit 1993 as in fn. 6.

\textsuperscript{8} Personal commentary Gente-Werner.

g. f. 47 v has the mirror image of f. 48 r, which makes it clear that at least in this case pressed specimens were tinted on both sides. In other cases one specimen was repeatedly used for producing an impression, e. g. the same specimen was printed on f. 50 r, 53 r and 54 r showing clear signs of increasing disintegration and breakdown. No doubt plant self impression is a rather crude method, but very suitable to the harsh conditions during an expedition in the wilderness of tropical America.

Humboldt and Bonpland seem to have been the first collectors who consistently numbered their entire botanical material in the field.\textsuperscript{9} This method is evident from their field books, the original labels accompanying many herbarium specimens, and from the annotations on the plant self impressions – the latter giving as a rule the collection number and often also a preliminary determination, both in the right hand upper corner. Most of these data are clearly in the hand of Bonpland [e. g. 137 r, Fig. 1; 95 r, Fig. 2], who is well known to have been the botanist of the expedition [see below], but in the case of the \textit{Cinchona} specimens all annotations are in the hand of Humboldt [e. g. f. 44 r, Fig. 3].

Judging from the collection numbers on the plant self impressions this technique was used over a considerable period during the expedition – in the modern countries Ecuador [e. g. f. 14 r, No. 2097; f. 95 r, No. 3342, Fig. 2; f. 137 r, No. 3394, Fig. 1; f. 44 r, No. 3413, Fig. 3], Peru [e. g. f. 84 r, No. 3481] and Mexico [e. g. f. 7 r, No. 3983; f. 75 r, No. 3998; f. 170 r, No. 4076].

Nothing is known about the transport of the plant self impressions to Europe: However, it is safe to assume that they were brought back together with the field books and personal belongings of the two travel- ers. Everything indicates that the material was kept in Paris and was therefore at the disposal of Bonpland who started the publication of the botanical part of the ‘Voyage’ with the first fascicle of the ‘Plantae Aequinoxiales’ appearing in May 1805. However, no dated annotation by Bonpland has been found in MS 998.

When breaking off from the project and emigrating to Buenos Aires in 1816 Bonpland took with him the precious field notes collected in six volumes, the so-called ‘journal botanique’ and very many herbarium specimens. This may also apply to the plant self impressions. Humboldt is known to have sent his botanical collaborator Carl Sigismund Kunth (1788-1850) to Le Havre asking Bonpland to return these materials immediately. Whereas the specimens sailed to South America and were to be returned to Paris only many years later, in fact the last part only after Bonpland’s death and just a year before Humboldt’s death and thus at a time when the publication of the ‘Voyage’ was long completed, the six volumes of field notes and possibly also the plant self impressions were successfully brought back by Kunth to Paris in 1816. Subsequently the ‘journal botanique’ was used as the backbone for his further work.

Consequently MS 998 contains many annotations in Kunth’s hand, giving determinations as published by him in the ‘Nova genera et species plantarum’, which form the fourth section of the botanical part of the ‘Voyage’. In rare cases he also added the locality on the plant self impressions, e. g. Havana [f. 135 v]. As a rule Kunth gave his notes, i. e. the scientific name, at the bottom end of the plant self impressions [Fig. 1, 2]: in a few cases he obviously felt unable to determine the image [e. g. f. 138 v].

Before leaving for Berlin in 1829, where he was appointed vice director of the Royal Botanic Garden in Schöneberg, Kunth donated this collection of plant self impressions to the wealthy banker, deputy, collector, maecenas and philanthropist Delessert, a key figure in the natural sciences in Paris and grand officier of the legion d’honneur. The plant self impressions were conserved in Delessert’s private musée botanique subsequently described under the heading ‘plantes imprimées’ [printed plants] as ‘choix de plantes du voyage de MM. Humboldt et Bonpland’ [selections of plants from the voyage of Mr. Humboldt and Mr. Bonpland] by Antoine Lasègue (1793-1873). Delessert’s last curator for botany.

After Delessert’s death his priceless musée botanique passed to his brother François Baron Delessert (1780-1868) who maintained it and even promoted further growth. Upon the latter’s death the library came into the possession of his daughters, the baronesses Hottinger and Bartholdi. They gave the library of the musée botanique to the Institut de France, and it was on this occasion that the title-page of MS 998 was marked with two rubber stamps ‘Legs Delessert’ and ‘Bibliotheque de l’institut impériale’. In contrast, the collections of the musée botanique were donated to the town of Geneva, where they became the founding stone of the well-known Conservatoire botanique.

12 Ibid.
13 Ibid.
15 Lasègue 1845 as in fn. 3.
Background

Both Humboldt and Bonpland may well have been aware of plant self impressions before they left Paris for their expedition, since the technique was not new. In fact the oldest specimen of this printing method is found in a Syrian Dioscorides manuscript from the thirteenth century, the method had been described in detail by Leonardo da Vinci in the Codex Atlanticus [c. 1493] and several botanical books have been illustrated using it.

Looking at plant self impressions in the eighteenth century from a geographical point of view it is evident that several well known works were produced in Central Europe, whereas comparatively few appeared in France. Berlin, Humboldt’s birth place, saw the production of Johann Julius Hecker’s ‘Flora berolinensis’, Berlin, 1757-8, and he may have heard from Willdenow of Johann Hieronymus Kniphoef’s ‘Botanica in originali’, Erfurt, 1747. Additionally Humboldt is known to have sent in 1797 two letters to Ernst Gottfried Badinger [1738-1804], editor of the Neues Magazin der Ärzte, who had them subsequently published in his journal. Four years earlier Badinger had had an anonymous announcement for a forthcoming publication printed in this journal – ‘Die Kunst Abdrucke von Pflanzen zu nehmen, worin eine neue vollkommener Art dieser Kunst geleht werden soll, will ein Ungenannten, auf einen Dukaten Vorauszahlung an die Verrentrappische Buchhandlung herausgeben’ [For one ducat advance payment an anonymous intends to come publication printed in this journal – ‘The art of making plant impressions, in which a new perfect way of this art will be taught’]. Nothing is known about a publication, but the method itself must have been known to the initiated.

Therefore it would be no surprise if Humboldt knew about this unconventional method of recording botanical specimens and applied it while with Bonpland in tropical America. Considering the division of labour among the two travelers in the field it seems however likely that the actual work was mainly done by Bonpland. The letters sent by Humboldt from the expedition to correspondents are full of references to the botanical work done by Bonpland. In his letter to Willdenow from Havana cited above Humboldt records for example: “I am very much satisfied... He possesses excellent qualifications of a travelling naturalist. He has dried the plants – including duplicates 12000 in number – all by himself...”

Since Humboldt annotated some of the plant self impressions it seems reasonable to attribute them to Bonpland and Humboldt [see legends].

Epilogue

In contrast to Humboldt and Bonpland earlier botanical expeditions in South and Central America were accompanied by professional illustrators – for example Martín Sessé y Lacasta and José Mariano Mozoño by Atanásio Echeverría and Vicente de la Cerda, Hippolito Ruiz and José Pavón y Jiménez by Joseph Brunete, Isidro Gálvez and others. Alejandro Malaspina and Thaddeus Haencke by José Guío, José del Pozo, Tomás de Suría and others. While in Havana in 1801 Humboldt is likely to have met Echeverría, since he mentions in his letter to Willdenow cited above ‘Echeverría dessen Talent im Pflanzenzeichnen ich mit nichts vergleichen kann’ [Echeverría whose talent in drawing plants I cannot compare with anything].

Humboldt may have felt this lack of a professional illustrator as a severe setback and decided to use plant self impression as an albeit hardly satisfactory alternative to record plant images. Later neither he nor his travel companion seem to have ever mentioned the technique. However, when writing his monumental ‘Nova generae et species plantarum’ Kunth made use of the plant self impressions and annotated them. In any case the use of this technique remained an isolated phenomenon – self impressions of botanical specimens are not known to have been prepared on any other expedition.

This is an updated version of a paper first published in Curtis’ Botanical Magazine ser. 6, 18: 218 – 229 [2003]. The copyright of the illustrations in this paper remains with the owner of the materials, a indicated.

References

20 Geus 1995 as in fn. 18.
21 ‘Mit meinem Reisegefährt Alexander Bonpland bin ich überaus zufrieden.... Er ist überaus tätig, arbeitsam... Er hat vortreffliche Eigenschaften eines reisenden Naturalisten... Die Pflanzen mit doppelten über 12000 hat er allein getrocknet...’ (Mohr 1993 as in fn. 8).
At the turn of the century, the Saas Valley was considered "one of the most beautiful and interesting landscapes not just of the Valais, but of the entire Alps". Yet, tourists who responded to an advertisement [fig. 1] and made their way to the Mattmark Hotel at the head of the valley were in for a double disappointment. Not only had the Allalin and Schwarzenberg Glaciers, in the wake of their advances and retreats over the centuries, left a bleak moraine landscape that stood in stark contrast to the otherwise gentle aspect of the Saas Valley, but the hotel in the picture was nowhere to be seen. What had happened?

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The Mattmark Hotel was built in 1856 on the shore of the lake, some two kilometres further south – and there it continued to stand. In the 1890 photograph that may have been used for the advertisement, the hotel is visible as a small spot in the far background (fig. 2). However, as the lake had receded more and more over the last half century, the hotel no longer stood on the shore but on the edge of a sandy plain. Apparently, it was hard enough to produce a halfway picturesque view of the area – unanimously described as dismal by mountaineers and naturalists – and so it seemed preferable to restore the hotel to its original location on the shore of the lake. Whether this pictorial transposition was done at the initiative of the owner of the hotel, Herr Mengis-Weissen, we do not know, but the fact remained: the hikers had another good half hour ahead of them before they could finally sit down and enjoy the hotel’s *gut­gepflegte Küche* [well-tended cuisine].

The main attraction of the Mattmark area was not the hotel, however, but another object that was just as movable, despite its remarkable size. What drew mountaineers and naturalists alike was a serpentine boulder over 20 meters high that had come to be called the Blue Rock [*Blauer Stein*] because of its gleaming bluish colour.
The mighty boulder fills the centre of this postcard from around 1900, seeming to push everything else out of the picture. To the right of the boulder there is a narrow track leading up a rather sparsely vegetated slope to the hotel. In the background, between the roof of the hotel and the boulder, one can see the terminal moraine of the Allalin Glacier, whose tongue projects into the picture on the left. All that is left of the lake is a plain scored with creeks and dotted with rocks. A man and a woman are standing directly at the foot of the Blue Rock, behind which runs a wide stream. He is leaning on his walking stick, while she poses on a rock above him, her stick nonchalantly propped on her right shoulder. The two are supposed to represent Sunday hikers or even hotel guests, who consider the barren Mattmark a worthwhile destination for an excursion and for whom a casual interest in natural phenomena presents a suitable leisure-time activity. The Blue Rock is evidently a sight worth seeing. One can walk around it, marvel at its different faces, verify its bluish colour and maybe even climb it. However, the postcard shows none of this. Instead, it focuses on a single aspect of the boulder: its sheer size. How heavy this rock must be! The couple is not even looking at the rock but toward the camera, as if to say: look how tiny we are and how huge this boulder is! The photographer selected his vantage point to make the boulder dominate its surroundings. This postcard presumes that its recipients will have some knowledge of the erratic origin of the rock: the ability of glaciers to carry huge boulders over long distances is intended to evoke wonder, and yet is presented in a matter-of-fact way. The glacier tongues visible in the background and seemingly touching the boulder proceed to deliver the explanation for the phenomenon. The Blue Rock may not have held any more glaciological secrets around 1900, but it could still be admired by the naïve tourist, graced with greetings to loved ones at home and sent off with the post.

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However, during the first half of the nineteenth century, erratic boulders like the Blue Rock were still the object of scientific controversy. Still in the summer of 1836, Louis Agassiz expressed hope at being able to bring his friend Jean de Charpentier, the famous explorer of glaciers, “away from his somewhat far-fetched notions.”

Charpentier had elaborated the theory that the presence of erratic boulders found everywhere in the Alps – even far from any glaciers – could be accounted for by glacier activity alone. In his opinion, this was the clearest

2 Louis Agassiz: Untersuchungen über die Gletscher. Solothurn: Jent & Gallemann 1841, p. 15.
Evidence for the immense power wielded by the force expansive of glaciers. According to Charpentier, this was unimaginable to anyone who had never seen the effects of this force on the objects that stood in its way. The glacier would overturn, compress and displace everything in its path, including the mightiest blocks of stone. "In 1818, the Schwarzenberg Glacier in the Saas Valley shifted a block of serpentine, which attracted the attention of the inhabitants of the valley owing to its gigantic size. They call it the Blue Rock. According to the measurements of M. Venetz, it has a volume of 244,000 cubic feet." For Charpentier, the Blue Rock was the "outstanding and undeniable proof in our time" of his glacier theory, and also a reason to reject the prevailing theory of fluvial deposition that these erratic boulders had been transported by former watercourses.

Charpentier's glacier theory seemed appealing enough to Agassiz, but not very plausible, for it meant that the glaciers of the past must have had gigantic proportions. And yet, as Agassiz wrote, in the course of their nearly five-month-long field trip to "inspect these remarkable phenomena," his ideas about erratic boulders gradually changed. The types of rock found in these boulders provided the best evidence for the continuous advance of glaciers and their ability to transport objects. Conclusive evidence was to come when they visited the Hugi hut on another trip three years later. The Swiss Alpine explorer Franz Joseph Hugi – ironically enough, a diehard advocate of the theory of fluvial deposition – had built this hut in 1827 at the foot of a cliff at the concourse of the Finsteraar and Lauteraar Glaciers. According to Charpentier, this was "outstanding and undeniable proof in our time" of his glacier theory, and also a reason to reject the prevailing theory of fluvial deposition that these erratic boulders had been transported by former watercourses.

Agassiz presented the Blue Rock as the "outstanding and undeniable proof in our time" of his glacier theory, and also a reason to reject the prevailing theory of fluvial deposition that these erratic boulders had been transported by former watercourses.

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In the lithograph executed by the artist who accompanied Agassiz, Joseph Bettannier, the hut can be seen in the right foreground, having considerably strayed to the middle moraine of the Unterer Glacier, as it is called there (fig. 4). Two men have made themselves comfortable in the hut, while another group stands at the edge of the glacier to study and sketch the many boulders being carried by the glacier. The phenomenon of "glacier tables" seems to have exerted a special fascination on the artist; in the left part of the picture, there are two such boulders apparently raised from the surface of the ice. A measuring rod has been raised on the boulder directly behind the hut, recalling Agassiz's exhortation to measure the hut's movement.

As far as proving the ability of glaciers to move and carry great masses was concerned, any object could serve as evidence: a travelling hut was just as good as an erratic boulder for explorers like Agassiz and Charpentier. But even if it showed that glaciers could transport erratic boulders over great distances, it did not prove that the presence of all erratic boulders could be...

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7 Agassiz: Untersuchungen über die Gletscher p. 138 f.
8 Ibid., p. 140.
9 This phenomenon occurs through the partial blocking of the sun's rays by a large boulder, such that the ice around it melts, leaving a small column underneath; see also ibid., pp. 116-120.
explained by glacier activity. How was one to substantiate the theory of a much greater extension of glaciers in the past?

Agassiz, a former critic of the glacier theory who had become one of its most fervent defenders, found the solution to the problem in the rocks themselves. One of the “finest results” of his field trip in 1839 was his successful conversion of the Bern geologist Bernhard Studer. Their search for traces of ancient glaciers was rewarded at the foot of the Riffelhorn, at an altitude of over 2,400 meters. What they found were “wonderfully polished spots” with grooves: “These grooves are not parallel, but occasionally intersect at right angles, and this could only have been caused by irregular movements as the ice advanced, pushing forward the quartz sand that scored these grooves.”

Water, it was argued, could never have left such traces. According to Agassiz’s companion, Edouard Desor, the rock was extremely hard; great effort was required to break off a piece that could later be published in the atlas. Studer, until then an advocate of the theory of fluvial deposition, began to have doubts. He was finally persuaded by a comparison with the surface of a rock under an existing glacier. “Are the striations clear enough, Agassiz asked triumphantly? There can no longer be any doubt, Studer replied, this is the proof! That was the finest result of the day.”

In the summer of 1862, more than twenty years after Agassiz, the French geologist and photographer Aimé Civiale found his way to the hotel on Mattmark Lake. From there, he wanted to pursue his “photogéologie” project, a photographic exploration of alpine geology. He, too, was subject to the strange melancholy that apparently befell the travellers to this area at the time. Although he could not imagine a more dismal landscape, as he wrote in his book Les Alpes au point de vue de la géographie physique et de la géologie (1882), he spent over two weeks at the hotel, executing a large panorama and a series of individual views. “During the fifteen days I stayed at the hotel, I did not see a single person pass by. I know of no gloomier place to sojourn than this, in spite of the wonderful view of the Strahlhorn looming above the Schwarzenberg Glacier.”

Apart from the mountain peaks all around, he was especially drawn to the many erratic boulders in the valley. “In the actual and former moraines of the Schwarzenberg Glacier there are many serpentine blocks strewn about, and their erratic origin is unquestionable... The great serpentine boulder is one of the most remarkable that I have ever seen. I have taken its average measurements: 20.73 meters long, 18.45 meters wide, 19.20 meters high, with a volume of 7,343 cubic meters; part of its surface is pocked [moutonné], polished and striated [strié], but the sharp edges in different places prove that it was transported on the surface of a glacier... I have taken a photograph especially [une épreuve spéciale] to show it [pour le représenter].”

Civiale’s photograph (fig. 5) is radically different from the one that was taken some forty years later for the postcard (fig. 3): it almost seems to represent a completely different object. The much lower vantage point makes the Blue Rock appear that much more imposing and hides the hotel behind it. Instead of being in an area –however dreary – already developed and equipped for tourism, the boulder in this picture lies in an unidentifiable wasteland. In the background, one can see the tongue of the Allalin Glacier, which reached much further then and blocked off the entire valley. The lake, which comes up to the foot of the Blue Rock, seems larger and divided by the moraine of the Schwarzenberg Glacier. The frozen appearance of its surface is due to the long exposure time required by the low sensitivity of Civiale’s wax-paper negatives. Rock debris and another, smaller, boulder can also be seen. The lack of cues as to scale makes the size of the Blue

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11 Ibid., p. 126.
12 Ibid.
13 Ibid.
Rock difficult to gauge, and the close framing makes its position in the landscape unclear. All traces of civilization have been carefully left out of the picture; it is almost as if the photographer had given expression to his own loneliness. The photograph concentrates on the mass, materiality and shape of the rock. It is so dense in its presence that one can scarcely imagine it moving. The high angle of the sun casts strong shadows that reveal the textured surface, but it is difficult for the viewer to identify, or even differentiate the pocked, striated and polished spots described by Civiale. Yet that may have been unnecessary by then: the glacier theory championed by Agassiz, Charpentier and Venetz had become generally accepted and Civiale’s mention of the traces with the standard terminology rings more like a refrain of facts established long before. He had nothing new to report about the Blue Rock; its “erratic origin” had become “unquestionable.”

What was the purpose of the photograph, then?

In his “photogéologie” project, Civiale had at least two objectives. The first and main objective was to offer a “complete representation” [une représentation complète] of the great chain of the Alps through panoramas and details.14 The second, complementary objective perhaps presented a much greater challenge: to establish photography as a medium for the earth sciences in the first place. Before Civiale, there had been isolated efforts to put photography at the service of geology and geography, but no one had undertaken a systematic effort as Civiale began doing on an annual basis since 1859. After nine years, he had produced over 40 large panoramas and almost 600 individual photographs. Each year he sent his latest works to the Académie des Sciences in Paris, where they were enthusiastically received. The geologist Léonce Élie de Beaumont, who had encouraged Civiale to pursue his project, pointed out the “faithfulness” of the photographs, in which details of the cliffs and glaciers that would have been difficult to draw could be reproduced.15

“Positive geology,” Charles Sainte-Claire-Deville commented, “which is based above all on the exact geographic coordinates of the diverse points on the surface of the Earth, can only reason with certainty from faithful [fidèles] representations of the peculiarities [accidents] of this surface.” He went on to say that Civiale had realised that this requirement could be satisfied only by photography.

In reading the report of the Académie, one gets the impression that the photographs themselves were not considered very closely; the enthusiasm was due less to the actual results than to the great expectations that were connected with this new medium. For the members of the academy, at least, the qualities of photography seem already to have been widely established in the 1860s. Beyond the controversies about the scientific potential of photography, it was apparently a matter of general agreement that this medium could represent the incidental forms and surface features of an object with the highest degree of accuracy. It still remained to be seen how it could be made useful for geology in particular. The picture of the Blue Rock, and especially Civiale’s description of it, was a fundamental part of this endeavour.

It was clear to every geologist that the Blue Rock was an erratic boulder that had been transported by a glacier to its present site. The kinds of traces that glaciers left behind on rocks were also common knowledge. Thus it was not a matter of proving that these traces were indeed there, but rather of demonstrating photography’s ability to make the erratic boulder visible as an erratic boulder. Consequently the traces on the surface of the rock were no longer seen primarily as indications of glacier activity. Instead, they were indications of the effectiveness of the yet-to-be-established medium of photography. Apart from the size, it seems to have sufficed that the irregular surface texture of the rock could be identified at all. Civiale did not need to show exact evidence of the polished or striated surfaces at this point.

Like the Mattmark Hotel and the Hugi Hut, the Blue Rock was a remarkably movable object in spite of its great mass. Contrary to the others, however, it strayed not only down valley, from the Strahlhorn to Mattmark Lake, but also horizontally, through completely different contexts and demands. In addition to its biography as an object of scientific and touristic interest, the Blue Rock had a considerable photographic career. In contemplating Civiale’s photograph, one cannot help thinking that it was especially well suited for the part.

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Notes on contributors

Gianenrico Bernasconi is a predoctoral research fellow at the University Paris I (Panthéon-Sorbonne) and at the Hermann von Helmholtz-Zentrum für Kulturtechnik, Humboldt-University, Berlin. His research concerns the history of portable objects in the pre-industrial Europe.

D. Graham Burnett is an associate professor of History and a member of the Program in History of Science at Princeton University. His new book, *Trying Leviathan* will be out in autumn 2007.

H. Walter Lack is director at the Botanical Garden and Botanical Museum Berlin-Dahlem and professor at the Free University Berlin. His research interests include the taxonomy of *Asteraceae* as well as the history of systematic botany and scientific illustration.

Anna Maerker is a postdoctoral research fellow at the Max Planck Institute for the History of Science, Berlin. She has published on the history of collections and specimens and on the history of scientific expertise in the eighteenth and nineteenth century.

Susanne Pickert is a predoctoral research fellow at the Max Planck Institute for the History of Science, Berlin. Her research concerns the history of geology and its objects from the middle ages until modern times and medieval travel accounts and the history of visual experiences.


Jan von Brevern is assistant professor at the chair of science studies at the ETH Zurich. His work investigates the Alps as space of knowledge production.
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Catalogue fig. 3 from Gustav Rose, Beschreibung und Eintheilung der Meteoriten, in: Physikalische Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin 1863 [1864], p. 23-121, Taf. I Abb.8, Staatsbibliothek Berlin
