Image and Reality: Perception, Depiction, and Preservation of Nature

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We often find rhinoceroses in unexpected places, but even so, we were surprised to find two of them in Tunja, Colombia, one on the ceiling of a house built in 1539 (figure 1a), the other on the ceiling of a house built in 1590 (figure 1b).

Figure 1. (a) Rhinoceros in the Casa de Suárez Rendón, Tunja, Colombia. Photo by J.E. Simmons. (b) Rhinoceros in the Casa de Juan de Vargas, Tunja, Colombia. Photo courtesy Diego Perico.

In both cases, the rhinoceros image was copied from a book on architecture written by Juan de Arfe and published in Seville, Spain, in 1587, but we recognized them immediately by their resemblance to Albrect Dürer's famous "boilerplate rhinoceros" of 1515, and marveled at just how far an image can travel.[1]

In 1515, the German artist Albrect Dürer (1471–1528) created an illustration of a rhinoceros that has been a popular, frequently replicated and caricaturized image for nearly 500 years. The depicted rhinoceros arrived at Lisbon on 20 May 1515 as a gift to King Manuel I (1469–1521) from Sultan Muzafar II (?–1526) of Gujarat in Western India. Dürer did not see the rhinoceros himself, but based his drawing on a description and a sketch by Moravian artist Valentim Ferdnandes (?–1519) who had access to the animal before it died. In his interpretation, Dürer patterned the rhino's hide on the armor of German knights of the era, and modified the angle of the horn to make it look more dangerous and to enhance the menacing look on the beast's face.[2] The drawing (figure 2), which is now in the collection of the British

Museum, was then meticulously transferred to a block of wood in order to produce multiple copies (figure 3).

Figure 2. Dürer's original sketch of the rhinoceros based on a description and piece of skin. Image © Trustees of the British Museum, used by permission.

Figure 3. Print from Dürer's woodblock of the rhinoceros. Image © Trustees of the British Museum, used by permission.

Figure 4. (a) Woodblock and (b) print from Pietro Andrea Mattioli (1501–1588). Photograph by J.E. Simmons.

Dürer had the choice of using woodblock or copperplate—copperplate could produce finer lines and shading, but a woodblock could be printed on the same page as text and woodblocks were more durable than copperplates. Text to be printed was set in type as a series of reversed letters (when printed they would be readable); likewise, the image carved on the face of the woodblock was reversed when printed (figure 4).

The woodblock that Dürer carved of his rhino was used to print at least nine editions of the image—the block continued to be used long after Dürer's death, even after the wood had cracks and holes in it. The printed image of Dürer's rhino was copied by Conrad Gesner (1516–1565) in a book published in 1551, resulting in a reversal of the image; the image was reversed again when Gesner's version was copied by Matthäus Merian the Younger (1621–1687) in 1658 (figure 5). Merian also added detail and reinstated the landscape seen in Dürer's original print. The repeated use and reinterpretation of Dürer's now iconoclastic rhino can be seen as an archetype of how nature has been perceived, depicted, and preserved over time. Juan de Arfe copied the image (figure 6) for his book on architecture from Gesner—the rhino has been reversed back to the way it was in Dürer's print, but without the landscape in Dürer's original print. These are examples of how advancements in European printing technology, paper making, and image reproduction helped disseminate and popularize the "boilerplate rhino" of Albrecht Dürer, even to a place as remote as sixteenth century Tunja, Colombia.

PERCEPTION

Modern natural history collections evolved from the cabinets of curiosities of Renaissance Europe.[3] The collections in these early cabinets were assembled in an attempt to find order in the chaos of nature. By the mid-sixteenth century, unfamiliar species brought to Europe from expeditions to new lands

were confounding the existing system of order and the dominant classification scheme used in the cabinets of curiosities, the *scala natura* of Aristotle (384–322 BC). Aristotle believed that all animals

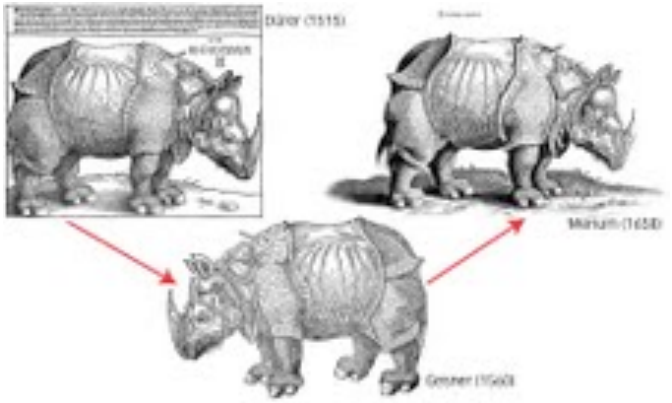

Figure 5. Evolution of the rhinoceros image from Dürer to Merian the Younger.

Figure 6. Rhinoceros from *Varia Commensuración para la Escultura y Arquitectura* by Juan de Arfe y Villafañe (1587).

could be fit into a progression of increasing perfection, from the lowliest invertebrate upward, culminating in human beings. Examination of illustrations of the contents of the cabinets of curiosities can tell us much about the state of preservation of the specimens that were reaching Europe, as well as and how artists and scientists together attempted to fit the new species in with what they already knew about nature.[4] Many early graphic depictions of previously unknown animals were constructed as extrapolations from known European species and poorly preserved specimens, embellished by descriptions from travelers. The perception, interpretation, and description of new species was constrained and influenced by the European artists' and scientists' prior knowledge and cultural framework.[5] For example, the earliest illustrations of tree sloths from the Americas depicted the animal

sitting upright, because Europeans thought that sloths were primates—no one imagined that sloths hung upside down by their claws. We found a reverse example of this phenomenon in a New World adaptation of the Old World convention in a sixteenth century Peruvian painting by native artist Marcos Zapata, "La Ultima Cena" (The Last Supper) that hangs in the Cathedral of Cuzco, Peru. The painting shows Jesus and his disciples feasting on a roasted guinea pig, a New World species often consumed on special occasions in the Andes (figure 7).

It was Carl Linnaeus (1707–1778) who brought the first real order to the chaos of the mix of known and unknown species.[6] In the library of the Academy of Natural Sciences in Philadelphia, we examined a rare first edition of Linnaeus's masterwork, *Systema naturae*, published in Leiden in 1735. There are no illustrations in this or any of the subsequent twelve editions. Linnaeus didn't think much of illustrations and referred to them as "icons," but nevertheless he based many of his species descriptions

Figure 7. *La Última Cena*, Marcos Zapata (ca. 1750), Catedral de Cuzco, Peru.

on illustrations of plants and animals he had never seen, alive or preserved. At the time, botanical illustration was much more accurate than the illustrations of animals, probably because the study of plants was more standardized (and less hampered by mythology), and plant specimens were more easily preserved than animals (the practice of pressing plants and arranging herbaria has been carried out since the early sixteenth century; the oldest known herbarium was established in 1532).[7] Similarly, many illustrations of human anatomy from this period were excellent—detailed and exact—especially those of Andreas Versalius (1513–1564), and based on dissections of cadavers.[8] If the artists had the ability to create such good illustrations of plants, human anatomy, and animals that were known to them, why couldn't they produce more exact representations of the new species arriving from the Americas? It was in part because of the lack of live specimens or well-preserved specimens, in part because many of the new species could not easily be classified in the *scala natura*, and in part because of the continued influence of the representations of mythological animals of the old bestiaries—people were still willing to

believe that the beasts existed, somewhere. As one author put it, "…the plant or animal in question underwent a considerable abstraction and distillation on its way to becoming a scientific illustration."

DEPICTION

The catalogs of collections of early collectors such as Gesner, Ulisse Aldrovandi (1522–1605), and Albertus Seba (1665–1736) marked the acceptance of illustrations as a means to convey authentic information about nature. These illustrations played a leading role in disseminating knowledge throughout Europe.[9] Printing technologies allowed drawing, like writing, to become a means of widely broadcasted communication. It has been said that printing provides an "exactly repeatable visual statement." What is often overlooked is that the illustrations used to study and prepare the learned treatises became a distinct pictorial genre all by themselves. These works were produced with two different audiences in mind—natural historians and collectors of fine art. The illustrations served both for scientific instruction and aesthetic appreciation because neither audience alone could support the production of these expensive, lavishly illustrated books. Gesner's *Historia animalium*, for example, published between 1551 and 1558, contained more than 4,000 woodblock prints. Carving woodblocks and engraving copperplates was a laborious and tedious task. In some cases, the artists themselves prepared the blocks and plates, but more commonly this task was handed off to specialized artisans. Images were frequently reused, both due to the expense of making a new block or plate and because of their popularity. Hand-coloring of the black and white printed illustrations added value to the work, particularly among collectors of fine art, but it was very expensive and the colors were not necessarily accurate.[10]

PRESERVATION

Very few dry specimens from the cabinets of curiosities of the sixteenth and seventeenth centuries exist today. The quality of the specimens reaching Europe was limited by the available preservation technology and the constraints of travel. Often, only parts of specimens survived the journey, such as a dried skin, a shell, or a mummified foot. For thousands of years, the only means of preserving specimens was to dry them and coat them with varnish, which resulted in specimens that were shrunken, distorted, and darkened. Preservation of biological materials in alcohol did not begin until 1662.[11] In our research, we have examined both dried and fluid preserved specimens from the late 1500s on in Stockholm at the Naturhistoriska Riksmuseet (National Natural History Museum) and at the Boerhaave Museum in Leiden. A paper published in 1748 (Reámur) summarized the known techniques for preserving specimens as (1) remove the skin, stuff it, and dry it (without any preservatives); (2) put the whole specimen in alcohol; (3) empty the body cavity and embalm the specimen with spices; or (4) gut the specimen then dry it in the oven (the author recommended immediately after the bread is baked). The

preservation technology used can usually be determined by studying the contemporary illustrations of a specimen, coupled with an understanding of contemporary preservation technology, materials, and techniques used in producing and reproducing illustrations. Paper was not made in Europe until the 1100s, and remained expensive and difficult to obtain until the 1400s. From the Renaissance onward artists made drawings on paper using a variety of materials, including black and red chalks, charcoal, pen & ink, washes, and watercolors. As a greater variety of fine grades of drawing and printing papers became available, artists were able to produce more nuanced drawings than had previously been possible, and more finely detailed and sophisticated illustrations could be printed. To replicate a painting, the composition had to be recreated as a line drawing. The drawing could then be transferred to a block or plate and printed, and the print could be hand colored. Woodblock printing was in use prior to 1400, and by 1430 artists were also using intaglio (the image incised into a metal plate). By the fifteenth century, copperplate was an option for reproducing drawing, and chiaroscuro (the use of multiple printing blocks to make color images) became available around 1508. Lithography (using an image drawn directly onto smooth limestone) did not come into use until the late 1700s. The printing press came into use in Europe around 1439 and was adapted to accommodate printing matrices of wood, metal, and stone as they came into use.

Until well into the eighteenth century, printing technology was inadequate to make accurate reproductions of the work of some artists. A good example is the work of one of the more remarkable artists of the time, Maria Sybilla Merian (1647–1717).[12] Merian was so fascinated by biological metamorphosis that she moved to Suriname from 1699–1701 to observe, sketch, and paint from live specimens. Merian's images were arranged on the page for artistic appeal. Her original work was intended for art collectors because no printing methods were available during her lifetime that could reproduce her paintings. Merian's watercolors are very accurate because she had the opportunity to observe the specimens in the wild. To reproduce the original paintings, the images had to be converted to line drawings, incised into wood blocks or metal plates, printed, and then hand colored. In Stockholm, we examined several specimens of the Suriname toad (*Pipa pipa*) that were preserved in brandy by Merian and brought back to Amsterdam to sell (figure 8). The difference in accuracy between Merian's depictions, which were based on her field observations (figure 9) and other contemporary illustrations, which were based on the preserved specimens (figure 10) is striking.

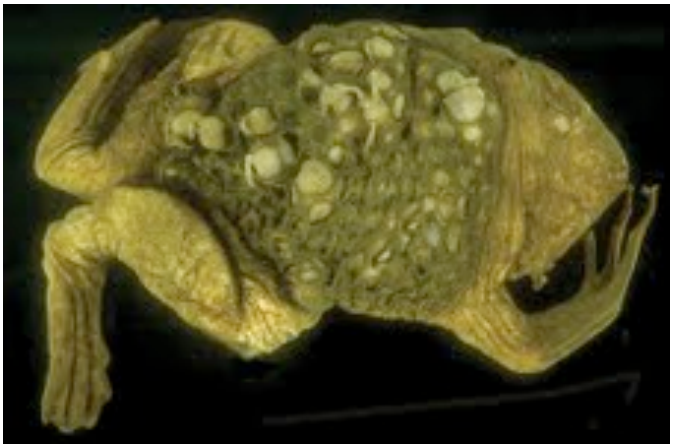

Figure 8. Surinam toad, *Pipa pipa*, Museum Adolphi Friderici collection.

Figure 9. Surinam toad, *Pipa pipa*, from Maria Sybilla Merian, *Metamorphosis insectorum Surinamensium* (1705).

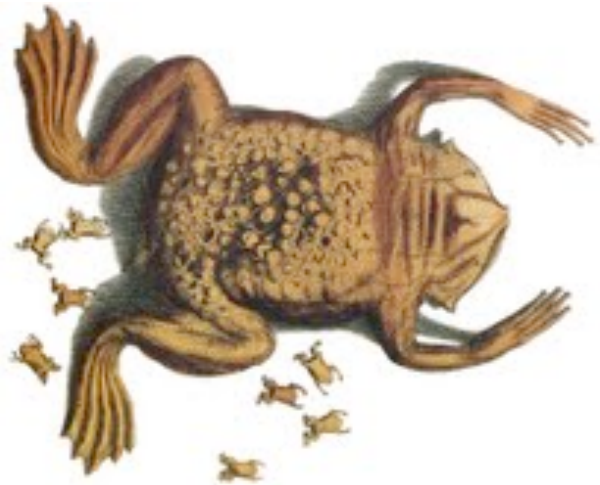

Figure 10. Surinam toad, *Pipa pipa*, Seba's *Thesaurus* (1734).

Although many lizard species were known to Europeans prior to their contact with the Americas, the large green iguana was a new discovery. The iguana depicted in Seba's *Thesaurus* (figure 11) has an exaggerated tail curled in an unnatural position, and because of the accuracy of most of the animal's features, it is reasonable to assume that the illustration was based on a well-preserved specimen but arranged for aesthetic appeal on the page. By contrast, Louis Feuillée's (1660–1732) field sketch of a West Indian iguana (figure 12) shows the straight lines used as part of measuring system to ensure proper dimensions, although the illustration was adapted to fit within the format of the paper. The materials that were available still affected how specimens were depicted—as one scholar has pointed out, "It may even be true that no single factor has influenced scientific illustration as much as the convention of rectangular paper."

Figure 11. *Iguana iguana*, Seba's *Thesaurus* (1734).

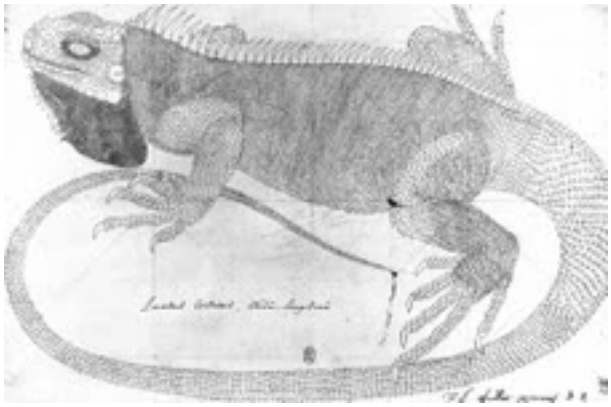

Figure 12. *Iguana iguana*, field sketch by Father Luis Feuillée (late 1600s).

An example of how the necessity of extrapolation from known species could limit the accuracy of an animal illustration can be found in the history of depictions of the armadillo. Armadillos were unknown in Europe prior to contact with the Americas. With their strange morphology, armadillos were sometimes depicted as turtles because they had shells (figure 13). Even as exacting a scientist as Gesner made mistakes. The inaccurate depiction of the prancing armadillo (figure 14) in Gesner's *Historia animalium* (1551) was based on a crude drawing and a shell sent to him from a colleague in Paris.

The armadillo was one of the most common exotic animals in the cabinets of curiosities of the sixteenth century because their shells were easy to dehydrate and ship back to Europe. The lack of good specimens (and live examples) meant that for almost 100 years, depictions of armadillos by European artists continued to be inaccurate. We examined an armadillo specimen known to have been studied by Linnaeus in the Naturhistoriska Riksmuseet in Stockholm (figure 15), and by comparing it to the illustration in Seba's *Thesaurus* (figure 16) we were able to determine that it is the same specimen.

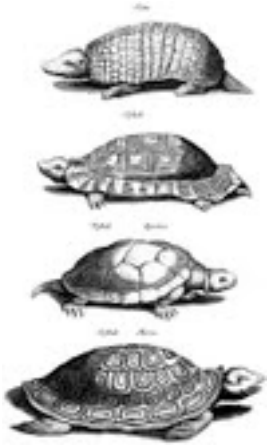

Figure 13. Armadillo (tatu) and turtles, Matthäus Merian the Younger (1650), *Theatrum universal onmium Animalium.*

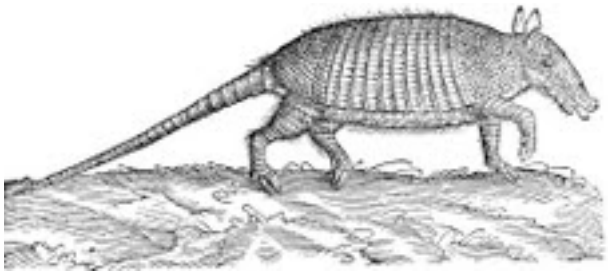

Figure 14. Armadillo, Gesner's *Historia animalium* (1551).

Figure 15. Armadillo specimen studied by Linnaeus, Museum Adolphi Friderici collection.

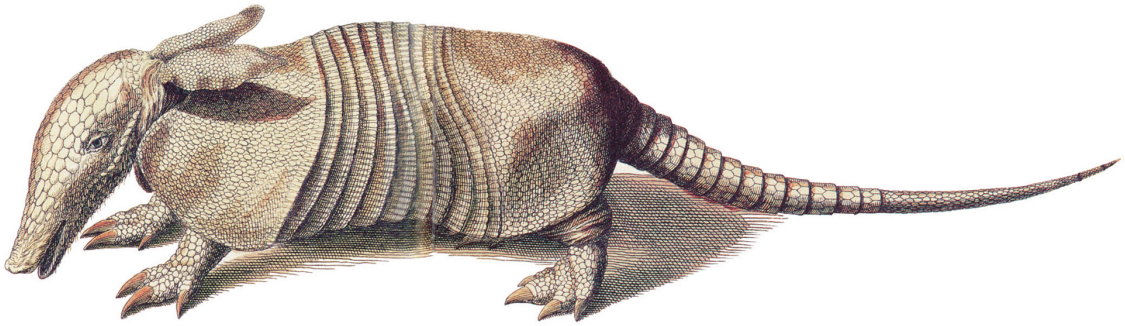

Figure 16. Armadillo, Seba's *Thesaurus* (1734).

The key characteristic that allowed our identification is an unusual indentation in the rear part of the armadillo's shell, which we discovered was caused by the specimen resting on the convex bottom of the container it is stored in (bear in mind the illustration is a mirror image of the animal itself)—when the specimen was removed from the container, the indentation was not visible; the drawing would have been made while the specimen was still in its container to prevent it from becoming dehydrated. The 1766 armadillo illustration published in Buffon's *Histoire naturelle, générale et particulière* (figure 17) still wasn't realistic (the armadillo is depicted in front of a scene from ancient Greece in homage to the *scala natura* of Aristotle). By comparison, the illustration of two armadillo species by Julianne was produced based on good photographs and well-preserved specimens (figure 18).

Figure 17. Armadillo, Buffon's *Histoire naturelle, générale et particulière* (1749–1804).

Figure 18. Extinct giant armadillo and extant nine-banded armadillo, illustration by Julianne Snider.

The horned frog, *Ceratophrys*, was another species that confounded artists. The Seba illustration (figure 19a) was based on a preserved specimen (figure 19b) that is now in the Naturhistoriska Riksmuseet in Stockholm. The 1802 illustration (figure 20) from Shaw's *Zoology* was copied from the Seba illustration—note that the image is reversed and it repeats the errors made in the shape of the eye, the digits, and the mouth.

Figure 19. Horned frog, *Ceratophrys ornata*. (a) Seba's *Thesaurus* (1734) and (b) Museum Adolphi Friderici collection.

Figure 20. Horned frog, *Ceratophrys ornata*, Shaw's *Zoology* (1802).

In illustrations, snakes were typically positioned in unnatural, awkward coils, in order to show both dorsal and ventral patterns, and to show the length of the snake. It has been suggested that these illustrations are of specimens that had been coiled in round containers when preserved, but prior to about 1800 most snake specimens were not coiled in neat spirals—glass containers were very expensive, difficult to seal, and prone to breakage so specimens of were usually preserved by dropping them into wooden casks filled with alcohol or liquor. We have examined numerous pre-1800 snake specimens in museums and found that very few of them show evidence of having been coiled up the sides of cylindrical containers. Wooden casks and barrels were recommended until the late 1880s for preserving specimens in fluid.

Changes in shape were not the only problem with specimens of the era—the colors of animals were often widely inaccurate because artists had to guess at colors in life due to the limits of preservation technology. When a newly preserved specimen was available, the results were often better. Seba's *Thesaurus*, published between 1734 and 1765 and based almost entirely on specimens in his private collection, was printed with plates in black and white, and sold in sections by subscription. Many of the purchasers hired artists to hand-color the plates in their volumes, thus greatly increasing the value of the work. An artist in Amsterdam named J. Fortuÿn (dates unknown) specialized in coloring the Seba plates and signed his work.[13] The preserved snake in figure 21a is a species that was green in life but turns blue in fluid preservative as a result of the loss of alcohol-soluble pigments and tissue shrinkage. We know that Fortuÿn saw the snake specimen in Seba's collection when it was relatively new because he has captured the color of the preserved specimen as it is shifting from green to blue. The preserved specimen that the image was based on (figure 21b) has now lost its all of its natural green color.

Figure 21. Color change in a specimen of Green tree boa, *Corallus caninus*), Museum Adolphi Friderici collection. (a) The artist captured the coloration as it changes from green to blue in preservative. (b) The specimen used in 21a, now devoid of green coloration.

Seba's illustration of an opossum (figure 22a) is based on the preserved specimen shown in figure 22b—note the position of the hind paws. Marsupials were unknown in Europe until the first specimens arrived from the Americas, causing great confusion among scientists.

Figure 22. Opossum (*Didelphis murinus*). (a) Illustration in Seba's *Thesaurus* (1734). (b) Specimen in Museum Adolphi Friderici collection.

The elephant embryo in Seba's *Thesaurus* is a very detailed drawing of a specimen in the Adolphi Friderici collection—note that the drawing, hand-colored (figure 23a), is a mirror image of the preserved specimen (figure 23b).

Figure 23. Elephant embryo (*Elephas maximus*). (a) Illustration in Seba's *Thesaurus* (1734). (b) Specimen in Museum Adolphi Friderici collection.

From 1500 until well into the nineteenth century, the artists illustrating the previously unknown species of animals usually had to work with poorly preserved specimens, their own knowledge of European animals, and common mythology in their interpretations of the specimens.[14] As more species were recognized and the cabinets of curiosities grew in renown, the scientific value and artistic value of the depictions of animals increased. Advances in preservation technology eventually resulted in better preserved examples arriving in Europe, and the artists responded to the demand for more precise illustrations and better reproduction of their illustrations. In the late 1700s, the collections of the old cabinets of curiosities were well on their way to becoming modern museums, collections of biological materials in particular were becoming systematic instead of random, and taxidermy techniques were being developed to preserve animals in more lifelike poses. The introduction of the Linnean classification system in the middle of the eighteenth century permitted the scientists and artists to include new species in a revised version of the *scala natura*, but it was the publication of *On the Origin of Species* and the theory of evolution by Charles Darwin (1809–1882) in 1859 that changed the perception of nature—the more exacting demands of the new science resulted in the demand for more exacting illustrations that were also less artistic in their presentation. Figure 24 shows a preserved specimen of a frog collected in1864, next to a specimen of the same species collected about 100 years later, in 1972, at the same locality, and the drawing published in 1875 of the original specimen.

Figure 24. *Colosthethus fuliginous.* (a) Holotype, collected in 1864. (b) Topotype, collected in 1972. (c) Published illustration of holotype, 1871.

The 1864 frog was collected by Marcos Jiménez de la Espada (1831–1898), who was a member of the Comisión Científica del Pacífico, in Ecuador. Although few specimens such as this survived because of the difficulties of preserving in alcohol in the field in the mid-1800s and the difficulties of transporting the specimens back to Europe, it is an example of a significant change in how specimens were obtained and depicted—scientists were now collecting their own specimens, and illustrations were made to serve science alone rather than both art and science.

By the 1850s, scientific collectors (who carefully recorded where specimens were obtained and preserved them specifically for use in research) were supplying most museum specimens. Scientific illustration had become a specialized form of depiction of plants, animals, and anatomy. In 1872, Charles Darwin became one of the first major scientists to illustrate his work with photographs instead of drawings when he published *The Expression of the Emotions in Man and Animals*.

Over the long history of the relationship between art and science, we can see how illustrations have functioned to transmit information about nature, while at the same time, how scientists and artists were both limited by their understanding of nature, cultural biases, mythology, and by the materials and technology at their disposal. The illustrations that resulted have, in turn, shaped the public's perception of nature. Consider the relationship between wombats and the Pre-Raphaelite Brotherhood in Victorian England. Wombats are very strange marsupials found only in Australia. The first whole specimen of a wombat to reach Europe was a specimen that arrived in England preserved in a barrel of brandy. The specimen was depicted in a not-very-lifelike way in a woodcut by Thomas Bewick (1753–1828), who was famous for his accurate depictions of animals, in the fourth edition of *A General History of Quadrupeds* (1800). In the 1860s, the Pre-Raphaellite artist Dante Gabriel Rossetti (1828–1882) saw wombats at the London Zoo, and soon obtained one for a pet. Named Top, the wombat was frequently mentioned in Rossetti's letters, and sketched several times, including a cartoon that Rossetti drew of himself mourning Top's premature death in 1869 (figure 25).

Figure 25. Gabriel Rossetti, *Mourning the Death of Top* (1869).

In an insightful book on the relationship between Victorians and exotic animals,[15] John Simons points out that the wombat followed a common pattern for the discovery of new species:

- Encounter and initial descriptions of the animal.
- Killing and often eating the animal.
- Preserving and/or capturing live specimens.
- Shipment of the specimens back to England or France.
- Publication of full scientific descriptions of the animal.
- Keeping the animals alive in public or private zoos.

Simons's description of this relationship parallels that of the discovery of other species new to Europe and their illustration:

> What the pattern consistently shows is an encounter with a strangeness that is described in fairly common terms, a striving towards a metaphor or analogy that will enable the Old World public to understand the nature of the new creature and, above all, an enchantment with the curious innocence of the Australian landscape, people, flora, and fauna.

There is much more to learn about how specimens were preserved and depicted, and how this impacted scientific and popular thought.

ACKNOWLEDGMENTS

We thank the Naturhistoriska Riksmuseet (Stockholm) for the photographs of specimens from the Museum Adolphi Friderici collection. All other images are public domain unless otherwise credited.

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