

# Watching Exotic Animals Next Door: “Scientific” Observations at the Zoo (ca. 1870–1910)

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## **Argument**

The nineteenth century witnessed the advent of the modern zoo. Nearly everyone who came to watch the exotic animals was a “lay person” in the sense that virtually none had formal training in zoology. This paper provides a typology of these observers: the zoo directors, assistants, keepers, animal painters, and the “common” visitor. What did they observe and what were their motivations? Did they pursue a certain agenda? What kind of knowledge, if any, did they produce? Soon the issue of the reliability of these observations emerged. Lay observers insisted on the veracity of their intimate and personal knowledge of animals while academics complained that their claims could not be generalized and were tainted by anthropomorphism. Hence the focus on the observations of these laymen will reveal contemporary assumptions on what may count as “scientific.” This is closely linked to the question of how far the zoo may qualify as a site of scientific investigation in the first place. The constraints on doing research on animals in a public space such as the zoo were numerous. Yet despite these obstacles the zoological garden contributed to the rise of ecological thinking as well as to the formation of ethology as a scientific discipline.

## **1. The “famous Mafuka,” a chimpanzee becomes a gorilla**

In the summer of 1875, the ape Mafuka, a main attraction at the Dresden Zoological Gardens, became an international sensation. While she had been considered a chimpanzee from the time she arrived two years earlier, some of her visitors now claimed that she was in fact a gorilla, a creature that no European except a few explorers had ever seen alive. Since the first description of this curious animal in 1847, all attempts to bring a living specimen to a zoo had failed, hence the excitement and also the national pride expressed in the German media. Yet the recategorization was disputed and the debate about Mafuka’s species continued until after her death in December 1875 (Hochadel 2008a).

During her few months of fame, a host of distinguished visitors came from all over Germany to visit her in her cage in Dresden, including Carl Hagenbeck, the famous Hamburg animal trader, and Heinrich Bolau, the director of the zoological garden in Hamburg. From Berlin, Germany’s political and scientific capital, the anatomist Robert Hartmann, his collaborator Carl Nisse, Ernst Friedel, the director of the provincial museum in Berlin, and Alfred Edmund Brehm, the famous popularizer of animal life,

paid their respects. Animal painters, Paul Meyerheim, Ernst Gessner, E. Reichenheim, Heinrich Leutemann, and Gustav Mützel came to the Dresden Zoological Gardens to draw Mafuka (Hartmann 1875a, 256; Nissle 1876b, 51). Their images of “the famous Mafuka,” as she was referred to now, appeared in popular magazines, animal encyclopedias, as well as scholarly journals.

The people who spent the most time with her were her keeper, whose name we do not know, and Albin Schöpf, the director of the Dresden Zoo. Schöpf acknowledged that Mafuka filled the zoo’s coffers because she attracted so many visitors (Schöpf 1874, 87). One of these visitors was Emil Ulrici, a local from Dresden, who we know practically nothing about except that he went to the zoo nearly every day in order to observe Mafuka. His suggestion that she might be a hybrid of a chimpanzee and a gorilla was widely discussed. Adolph Bernhard Meyer, the director of the Naturhistorisches Museum in Dresden, who would later translate the writings of Alfred Russel Wallace into German, published an article in the British magazine *Nature* about the debate (Meyer 1875).

The case of Mafuka offers a glimpse of the broad spectrum of people who observed animals at the zoo in a sense that went beyond the mere visual consumption of exotic animals in the late nineteenth century. In what follows, we shall have a look at animal traders, directors, assistants, and zookeepers, as well as animal painters, journalists, and visitors with some kind of “scientific” agenda. In each case, there will be short twin biographies so as to explore the range of each group as well as to draw parallels and contrasts. This sequence of “micro” case studies should help to address the following questions. What kind of observations did Mafuka’s visitors and other “lay” observers carry out in the nineteenth century zoo? What were their motivations in studying animals at zoos? Did they pursue a certain agenda? What kind of knowledge, if any, did they produce? Did they interact with each other in a productive or an antagonistic way? What were the specific skills and backgrounds that enabled and informed their observations? Were their observations considered reliable? Could the reports of a simple visitor or of a keeper with no academic training be trusted?

I will try to show how the continuous presence of exotic animals in urban settings enabled very different kinds of people to study their behavior in unprecedented ways. Because of the hybrid nature of the zoo, this space teeming with animals and also with people not only enabled research, it also threatened to sabotage it. Hence I will ask how far these specific conditions of the zoos influenced and limited the scientific observations made there. I will argue that despite these constraints, the zoological garden contributed to the rise of ecological thinking as well as to the formation of ethology as a scientific discipline.

The broader context for these “scientific” observations at the zoo is the long-lasting tension between university scholars, usually only interested in anatomy and hence dead animals, and the so-called “reform movement” in natural history which emphasized the need to investigate the living animal. This created a sort of parallel tension on an epistemological level: what kind of claims should the science of animals

consist of? Many of the lay observers at zoological gardens claimed to have intimate knowledge of individual animals due to their personal encounter and their frequent visits. Yet many academics considered this alleged strength to be a decisive flaw. They claimed that accounts of lay observers were tainted by an all too personal (and often anthropomorphic) perspective, anecdotal and unsystematic, and hence of limited or no use at all, compared to the kind of “rigorous” science the academics tried to promote and institutionalize. According to academics observations of lay people could not be used to create knowledge about animals by generalization. In other words the focus on observation in zoos made by “laymen” will reveal contemporary assumptions on what may count as “scientific.”

## 2. Toward ecology and ethology – the rise of the “reform movement”

The nineteenth century saw the advent of the modern zoological gardens (Baratay and Hardouin-Fugier 2000; Rothfels 2002a; Wessely 2008), starting with the Jardin des Plantes in Paris (founded in 1794) and the Regent’s Park Zoo in London (1828). Dublin (1831) and Amsterdam (1838) soon followed. Germany was a particularly “productive” territory, a dozen zoos were founded between 1844 and 1869 alone (Rieke-Müller and Dittrich 1998). The geographic focus of this article will be the zoos in Germany but I will also glance at the zoos in London, Paris, and Vienna. I will mainly consult sources from the time roughly between 1870 and 1910.

Annelore Rieke-Müller and Lynn Nyhart have convincingly argued for the existence of a “reform movement” in nineteenth-century Germany, the former with respect to the zoo and the latter with respect to natural history in general. This movement did “practical natural history”; it investigated animal life outside the institutions of academic zoology and was particularly concerned with establishing new forms of displaying nature in order to both educate and morally elevate the public (Rieke-Müller 1995; Rieke-Müller and Dittrich 1998; Nyhart 2007 and 2009). The zoo was an important site for this movement, next to natural history museums, voluntary associations (*Vereine*), and schools. Despite the heterogeneity of the reform movement with respect to its personnel and its different forms, it had one common goal: to shift the emphasis from the dead to the living specimen. David Friedrich Weinland, director of the Zoological Garden in Frankfurt, contended that no researcher could come up with a “complete idea” of the animal if it was dead: “Only the living animal is the entire animal.” Therefore the zoos “must put the animals in a situation where they can show their entire being” (Weinland 1860–61, 185, 187). He wrote this as editor of *Der Zoologische Garten*, an important journal of the reform movement (see below).

The reform movement evolved and acted in opposition to the predominant way in which animals were studied at the universities and academies of sciences, focusing virtually exclusively on taxonomy and anatomy. Ernst Friedel, a follower of Brehm, scolded the “Balg-Zoologe” (hide zoologist), “who has only taxonomy in his mind.

For him, animals are only alive when they are dead, when they are stuffed or lined up in spirit jars, ordered according to the newest textbook” (Friedel 1872, 331; cf. Brehm 1864, vii; and Nyhart 2009, 37). This polemic was not far from the truth. Robert Hartmann was interested only in Mafuka’s corpse and was rather annoyed when he had to travel to Dresden to see her jumping around in a cage, instead of her being delivered to his dissection table in Berlin (Hartmann 1875a, 250).

The reform movement was not per se anti-academic, for many of its proponents had a university degree. Yet there was always tension, not only in terms of different agendas but also in terms of the education and the professional situation of its proponents. In his study of the popularization of science in nineteenth-century Germany, Andreas Daum identified roughly twenty individuals as “professional popularizers” of the natural sciences. Although many of them held a Ph.D., “deviations from the academic norm were specific to this group.” Brehm for example submitted a few chapters of his *Reiseskizzen* (a popular science book!) and some of his articles from the *Journal für Ornithologie* to the University of Jena. He received his doctoral degree without a formal dissertation (Daum 2002, 392).

Although this needs further study, it seems that the naturalists who made up the reform movement in the German-speaking countries were often outspoken supporters of Darwin’s theory of evolution. This holds true for Brehm and Weinland as well as for the two Viennese naturalists Gustav Jaeger and Friedrich Knauer, all four of them being involved in founding and running zoos (for the latter two, see Hochadel 2003). By contrast, the majority of German anthropologists such as Rudolf Virchow, Robert Hartmann, Th. L.W. Bischoff, and Rudolph Wagner were very skeptical about the theory of evolution due to their static and ahistoric understanding of nature (Zimmerman 2001, 66–69).

The debate about the origin of man is an important context for what follows because the zoo became a medium for evolutionary theory, in particular, after the arrival of apes at German zoos after 1860. Leutemann revealed the kind of associations Mafuka triggered: “Ape, gorilla, orangutan, chimpanzee! Who, at the sight of these, does not think immediately of Darwin, Vogt, and similar greats, who are trying to make ever more clear to us what they believe to be our more likely relationship with these four-handed animals?” (Leutemann 1876, 95). This “zoo Darwinism” functioned through the primacy placed on entertainment and humor as well as in the ambivalent anthropomorphization that oscillated between drawing parallels between humans and apes and lines of separation (Hochadel 2010).

Yet this was rather accidental. The goals formulated by the founders of zoological gardens were different. To gather new knowledge about animals was central. Zoos provided, in Weinland’s words, the opportunity to study animals through “long and repeated observation” (Weinland 1860–61, 186). Directly connected with this self-set task of scientific observation was another core goal of the founder of zoos: the education of the broad public. This is where the program of the zoo intersected with the agenda of the reform movement. The immediate experience of living animals was supposed to

foster a sustained interest in and empathy for the natural world. Yet in order to survive economically, the zoological gardens soon had to make it their priority to provide enough entertainment to attract a sufficient number of visitors (Baratay and Hardouin-Fugier 2000, 146f; Rieke-Müller and Dietrich 1998, 265f). The goal of educating the public was, of course, never given up, but “compromises” with the predilections of the masses were deemed inevitable. Thus in the last third of the nineteenth century, the zoo became a site of mass culture, featuring huge restaurants, concerts, and pony rides for children. This blending of economic, pedagogical, and scientific motives and activities with the demands of the public for entertainment turned the zoo into a hybrid place. And it was precisely this hybrid character of the zoo that provided different groups of people with new possibilities to observe exotic animals and to interact with each other.

### **3. The old-fashioned Mr. Kraus and the revolutionary Mr. Hagenbeck – Zoo Directors**

The “displacement” of exotic animals forced the people in charge of zoos to study their habits and their special needs, their breeding and procreation patterns, and how they tended to their young (Nyhart 2009, 108). The shocking death toll of zoo animals made questions of how to transport, house, and feed them all the more urgent. The person in charge of the day-to-day business at the zoo was generally called “inspector.” The position of “director” was created only in the latter part of the nineteenth century because governing bodies of zoos, usually made up of wealthy citizens and aristocrats, needed a person of equal social standing to communicate with, and the inspector, rather a Dr. Dolittle-like figure, often did not meet that qualification (ibid., 119).

Many directors of the early zoos in Germany held an academic degree, mostly in the natural sciences or in medicine. Yet due to the commercialization of the zoo in the last third of the nineteenth century, an increasing number of animal dealers, showmen, and owners of restaurants founded and ran zoos (Rieke-Müller and Dietrich 1998, 265). At this point we will look at two directors that could hardly have been more different. Both were successful in their own way: Alois Kraus, who headed the Imperial Menagerie at Schönbrunn outside (now inside) Vienna for forty years (Heindl 2006), and the animal dealer Carl Hagenbeck, who revolutionized the display of animals with his “animal paradise” in Stellingen outside (now inside) Hamburg in 1907 (Rothfels 2002a).

Alois Kraus (1840–1926) served in the imperial Austrian navy from 1854 to 1871. Some of his chores were related to natural history: he gained experience as an animal keeper for Archduke Ferdinand Maximilian and worked as a taxidermist on some of the “scientific” voyages of the Austrian navy. In 1871 he became *Unteraufseher* (third highest position) at the Schönbrunn Menagerie. In 1875 he was promoted to *Unter-Inspector* and after the sudden death of the previous inspector in 1879, he was put in charge of running the zoo, at first on a provisional basis. At that time, the baroque Viennese

Menagerie – personal property of the Austrian Emperor – was widely perceived as backward and wanting in comparison to the zoos of other capitals, in particular, its “rival” in Berlin. Some of the Viennese newspapers immediately questioned Kraus’ credentials, for example the fact that he had no academic training at all – unlike many other directors of “modern” zoos. One journalist mentions five such directors, among them Brehm and Schöpf, the latter had a degree in pharmacy (Anonymous 1879, 2; Hochadel 2008b).

Kraus’ superiors asked him to come up with a reform plan for the Menagerie. In his memoir, he turned the tables on his critics and was very candid about what he thought about an all-too-academic approach: “A zoologist who knows the animals and their fabric down to the smallest detail only very rarely knows how to keep and sustain the animal in captivity.” Obviously in response to the allegations leveled against him, he maintained that it was not necessary to be a trained zoologist in order to run a zoo. Instead an inspector had to be knowledgeable about the *Lebensweise* (way of life) and the biogeography (as we would say today) of the animal. He had to observe the animal day and night in order to notice even a slight change in its habit.

Kraus made clear that he thought little of veterinary medicine applied to zoo animals. “Once an animal has fallen ill, there is generally very little that can be done.” That was what bitter experience had taught him. Faced with criticism on the high death rate among the animals of the Menagerie Schönbrunn, he pointed to a huge loss of wildcats at the zoos of Berlin and Dresden three years earlier, where dissecting the animals had not at all helped in identifying the cause of death (Heindl 2006, 187). Kraus, a loyal servant to the Austrian emperor, survived the public onslaught. He was able to reform the Schönbrunn Menagerie step by step and ran the institution until 1919. Over time, Kraus also became a member of several scientific societies. He tried to keep abreast of new developments but he did not publish any scientific articles (*ibid.*, 17f).

Occasionally he wrote about his journeys such as the one he undertook to South-East Asia in 1878 (Kraus 1879). His mission was to collect two young tigers donated to the emperor Franz Joseph I by the prince of Montenuovo from Java and to use the opportunity to acquire more animals from Java, Sumatra, Egypt, and other places en route. It is hard not to be impressed by what he achieved single-handedly. From Vienna he got onto a train to Trieste and nearly five months later he returned on the very same train loaded with boxes and cages, 82 animals, including three tigers, an orangutan, porcupines, antelopes, a Boa constrictor, and exotic birds. The observations on animals are anecdotal: Kraus tells us how to plant traps to catch tigers alive and how attached to him the young orangutan became on board the ocean liner. The Austrian public and his superiors were quite impressed and heaped praise and rewards on him (Anonymous 1878; Haus-, Hof- und Staatsarchiv Vienna, Obersthofmeisteramt 1878, 75/4).

Due to his extended experience with exotic animals, Kraus may be described as a self-made expert. Yet the things he knew and learnt can only be reconstructed indirectly by going through the vast archival material on the Menagerie Schönbrunn. Kraus was aware of the amount and kind of space ostriches and buffalos need to thrive;

he explained to his superiors what kind of heating is best suited to certain kinds of birds and what provisions needed to be made for animal transports. He wondered how to get deer used to the visitors’ gaze; he knew how to obtain and prepare food for specific animals; he urged that incest be prevented among the lions of the Menagerie (Haus-, Hof- und Staatsarchiv Vienna, Obersthofmeisteramt 1878, 75). His was applied knowledge.

Kraus was known for his expertise and was often called upon. German zoo-directors praised him for his successful efforts to modernize the Schönbrunn Menagerie. Government agencies and courts in Vienna relied on him for all kinds of expert reports dealing with exotic animals outside the zoo (in circuses, for example). Other naturalists and amateur scientists asked him to determine species and inquired how to feed rare animals such as caimans (Heindl 2006, 130–136). Although one would hardly describe Kraus as part of the reform movement in natural history, he had some ideas and attitudes in common with the movement. For him the careful and continuous observation of animals was essential. He was a “practical” man with well-concealed reservations against academics and their “theoretical” approach.

Carl Hagenbeck (1844–1913) had quite a different attitude to science. It has been repeatedly pointed out that university professors provided the necessary credibility for his ethnographic performances, which he started to launch in Germany in the 1870s. Virchow and other renowned anthropologists tried to dispel criticism that his shows were inauthentic and vulgar spectacles (Schwarz 2001, 65f; Zimmerman 2001, 19f; Rothfels 2002a, chap. 2; Bruckner 2003, 136–138). In exchange, the impresarios let the professors study the “natural” people on exhibition.

This mutual relationship of give and take was also common in the animal trade. The sheer mass of animals coming to Hamburg from all over the world provided extraordinary opportunities for naturalists. In 1883 Hagenbeck had more than fifty Asian elephants assembled, apparently enabling the otherwise little known German zoologist Theodor Noack to study the individual variation within the species to an extent that had previously been impossible in Europe (Noack 1884, 333; cf. Hagenbeck 1909, 93). As an animal dealer, Hagenbeck easily saw far more live animals than any academically trained zoologist. In 1882 he “discovered” an unknown kind of wild ass but then failed to convince directors of zoos of this fact. Noack came to his aid and baptized the wild ass *Asinus taeniopus somaliensis* in a publication of 1884. The same year Hagenbeck was able to sell the donkey to the London Zoo (Hagenbeck 1909, 93). Today this species is called *Equus asinus somaliensis* and it may well be the largest animal species “discovered” in a zoo (Denzau and Denzau 1999, 167, 176).

With respect to taxonomy, both Hagenbeck and Noack may be labeled “splitters.” Discovering new species and naming them was (and still is) a well-established method of boosting one’s scholarly reputation. At the same time splitting added value to the stock of the animal trader. Later Hagenbeck also employed a couple of trained zoologists for this purpose, among them Theodor Knottnerus-Meyer and Alexander Sokolowsky (Rothfels 2002b). In return for his “cooperation with science,” Noack

praised Hagenbeck in *Der Zoologische Garten*, a journal read by many of the customers of the animal dealer.

In the case of Mafuka, Hagenbeck was credited with the “discovery” that the chimpanzee was in fact a gorilla. Hagenbeck had visited Dresden with his brother-in-law and business associate, the London animal trader Charles Rice on 3 June 1875. Rice offered the zoo 24,000 Marks for the ape – twenty times the price Schöpf had paid in 1873 to purchase Mafuka (Leutemann 1876, 95). Hagenbeck’s visit to the Dresden zoo and Rice’s offer marked the beginning of the Mafuka debate. The rumor spread that she was a gorilla (Lichterfeld 1875, 299). There is no direct evidence for why Hagenbeck thought Mafuka was a gorilla. Given the close relationship between Hagenbeck and Leutemann, it is plausible that the animal painter specifically alerted the animal dealer to the curious pigmentation of Mafuka’s face. In fact, Leutemann had already, after his first visit to Mafuka in August 1873, publicly uttered his conjecture that she might not be a chimpanzee (Leutemann 1874, 64).

Hagenbeck certainly was an acute observer. His autobiography *Of Animals and Men*, first published in 1908, a long-time bestseller, is teeming with stories on the behavior of all sorts of animals. Yet – and in this respect he does resemble the practical minded Alois Kraus – his observations were always instrumental and intimately connected with his business as an animal trader and zoo director. Taming, acclimatizing, feeding, and breeding animals were part of his everyday business. Hagenbeck’s style may best be characterized as anecdotal. He talks about his personal experiences with exotic animals, often referring to them as individuals. He “knows” them and they “know” him, even if he encounters them years later in a zoo he once sold them to.

*Of Animals and Men* in a sense became the paradigm for numerous autobiographies of zoo directors that have appeared since. These books are meant to entertain the reader and portray the director as a savvy, jovial, and fearless animal-lover and successful improviser. Many of his observations were owed to unforeseen coincidences. For example Hagenbeck tells the story of how the sudden onset of cold weather “taught” him that cranes can actually survive the European winter (Hagenbeck 1909, 340f). This in turn led him to start his own “experiments in acclimatization” on ostriches, antelopes, cats of prey, and other animals. Given the opportunity, he successfully crossed lions and tigers and failed to cross other species of cats of prey with each other (ibid., 221f). In *Of Animals and Men* he dedicates an entire chapter to apes (ibid., 401–412). He highlights their abilities to learn by imitation and characterizes chimpanzees as naughty and orangutans as phlegmatic – very much like the “comparative ape psychology” developed by Nissle and Sokolowsky described below. With respect to different species he stresses how important companions are for the wellbeing of the animals (ibid., 346, 348, 409).

When Hagenbeck designed his new Tierpark in Stellingen, he had to go beyond the mere observation of animals. He experimented to find out how far animals could jump in order to build sufficiently broad moats around his enclosures, allowing the visitor to see the animals unobstructed by bars and fences. In a sense, his “animal paradise” was



the pinnacle of the reform movement, showing different species mingling in “real” nature and roaming “freely.” Carl Hagenbeck remains an ambiguous figure: On the one hand he stages his Tierpark as Noah’s Ark and deplores the depletion of many species in the wild. On the other hand his business as an animal trader contributed heavily to the destruction of wildlife while his Tierpark served as a “holding station” for animals to be sold worldwide (Rothfels 2002a, 185f).

#### **4. The observant Mr. Nissle and the empathetic Mr. Sokolowsky – Assistants**

Toward the end of the nineteenth century an increasing number of graduates in zoology were looking for employment. Quite a few of them became curators at the newly founded or reformed natural history museums (Nyhart 2009, 203–214). The level of curator had no proper equivalent at the zoo. There was not much of an intermediary level between the director (and/or inspector) at the top and the keepers and administrative personnel at the bottom. The first position for a paid scientific assistant in a zoo was not created until 1904 at the *Zoologische Garten* in Berlin. It was filled with the ornithologist Oskar Heinroth (Frädriich and Strehlow 1994, 169). In other words: there were quite a few trained zoologists floating around, trying to make a living by writing popular science articles and books, such as Carl Nissle and Alexander Sokolowsky, two little known naturalists. They both based a good part of their writings on observation in zoos and developed a kind of “animal psychology.”

Carl Nissle was probably born in Berlin in 1839 and began to study philology and history (Forum Ahnenforschung 2010). We know neither the subject of his doctoral degree nor how he made the transition to “zoologist” which is how he described himself. In the 1870s he published several articles in the *Zeitschrift für Ethnologie* and in the popular science magazine *Die Natur*. They are all based on visits to zoos and relate observations of apes. Nissle traveled from Berlin to Dresden at least three times between July and December 1875 to see Mafuka. He acted as an informant or even as a kind of assistant to Robert Hartmann, although the nature of their relationship is not clear.

The case of the Dresden ape offered Nissle an opportunity to make himself known. The first part of his lengthy article on “Die Dresdener Mafuka” was dedicated to setting the record straight. Nissle conceded that Hagenbeck was the first to give “indications” that the chimpanzee might in fact be a gorilla. Yet Nissle claimed to have been the first to argue this with sound and scientific arguments in print and scolded Brehm for assuming priority in this respect. Nissle also attacked Bolau, who insisted that Mafuka was a “nearly adult” chimpanzee, for misinterpreting her dentition. And finally Nissle criticized other zoologists for casting judgment on her species without having seen her personally, having relied solely on images. His own expert credibility rested on his personal experience. He had seen many chimpanzees and also orangutans, mostly at the Berlin Aquarium – despite its name also a zoo (Nissle 1876b, 46–49).

In the second part of his article, Nissle summed up the arguments in favor of Mafuka being a chimpanzee or a gorilla. He was very circumspect in trying to reconstruct what he called the “biological side,” i.e. where exactly she was caught in Africa and how old she had been. Despite his connection to Hartmann, a hardcore physical anthropologist, Nissle was very interested in the living ape. He described her outer appearance and took her wild behavior as another point in favor of her being a gorilla. Nissle observed her frequent mood changes oscillating between “bestiality” and “placidity and kindness.” Mafuka’s sudden outbursts made her quite unpredictable. One night during a thunderstorm that obviously agitated her, the ape brutally killed her long time companion, a small monkey. Nissle was the only one of many observers who stressed that her behavior was quite wild at times.

Nissle’s and Schöpf’s attempts to take measurements of her limbs and other parts of the body were unsuccessful because she would not stay still. That also made it difficult to look at her teeth to determine her age (*ibid.*, 55). Nissle was one of the first to propose what we may call comparative animal psychology. To modern readers many of his characterizations may seem blatantly anthropomorphic. Yet Nissle’s observations of apes included several settings and aspects (interaction with keeper, sounds uttered, sickness) and helped to clearly distinguish the behavior of the orangutan from the chimpanzee. The orangutan is “phlegmatic” yet becomes seriously annoyed when the daily routine is not adhered to. The chimpanzee on the other hand is a “perpetuum mobile” moving around all the time, a very apt imitator and always up for a prank (Nissle 1876a, 462). The chimpanzee’s vocal range is much broader than that of the orangutan. Nissle even held that the orangutan and the chimpanzee suffered in different ways. Nissle described Mafuka’s actual death on 14 December 1875 in touching detail: she embraced director Schöpf, kissed him three times and finally shook his hand as if to bid her longtime friend goodbye before she fell asleep never to wake again (Nissle 1876b, 59; cf. Nissle 1876a, 462). This report of her last hour was reprinted and in abbreviated form translated into English (Smith and Wake 1880, 450).

However, despite these efforts, Mafuka did not bring scientific recognition to Nissle. His deeply sympathetic description of her last hours “provoked the mockery of unknown enemies of modern animal psychology” as he put it himself (Nissle 1876b, 58). It is not clear who tried to ridicule him but apparently he was accused of unabashed anthropomorphism. The British journal *Nature* picked up on his description but mistook him for an artist (Anonymous 1875). Bolau preferred to quarrel directly with Hartmann who had much greater visibility (Bolau 1876; Hartmann 1877). We lose track of Nissle after 1876.

Alexander Sokolowsky, born in 1866, had studied zoology in Jena under Ernst Haeckel and in Berlin under Karl Möbius (Sokolowsky 1928, 15–17). Yet because he had no *Abitur* (high school diploma) he had to go to Zurich to obtain a Ph.D. (Daum 2002, 392). He published articles on zoology as well as a handful of books. They were “written for an educated, but not specifically scientific public” (Rothfels 2002b). He had a hard time finding a salaried position and often worked unpaid in

zoos and museums in Berlin. In 1906 he started to work as an assistant for Hagenbeck in Hamburg. Nigel Rothfels has argued that Sokolowsky was useful to Hagenbeck for two reasons: Firstly because of his expertise as a zoologist and taxonomist, being able to evaluate and possibly increase the value of his stock, and secondly because of his ability to speak to the general public about scientific matters in an intelligible way. As Hagenbeck’s “propagandist” he advocated the “biological principle.” “Instead of showing animals as only unfortunately moving versions of natural historical objects organized according to taxonomic order, Sokolowsky insisted that zoos embrace the living, breathing, moving animal and show how it was connected to its environment” (ibid.). The way Sokolowsky portrayed Hagenbeck’s “animal paradise” made it seem the penultimate realization of the goals of the reform movement. The outdoor display in Stellingen would be more natural and healthier for the animals than the traditional cages and enclosures, more conducive to scientific study, and more instructive and elevating for the public.

Working at Hagenbeck’s zoo provided Sokolowsky with ample opportunity to observe animals. He published two slim books, *Beobachtungen über die Psyche der Menschenaffen* (Observations on the psyche of apes) in 1908, and a more general one entitled *Aus dem Seelenleben höherer Tiere* (The psychological life of higher animals) in 1910. He tried to capture the mental states of higher animals and relate them to their actual living conditions. He only observed animals and did not conduct any experiments. Sokolowsky even reported the use of tools by capuchin monkeys – they opened nuts with the help of stones. Yet he himself considered his observations of little scientific importance. Only observations made in the wild would give unambiguous evidence that monkeys or apes would be able to use tools spontaneously. Sokolowsky believed that the use of tools distinguished man from beast and hence could not imagine that animals would use tools in cases other than imitation (Sokolowsky 1910, 67). Nowadays we know that capuchin monkeys do use tools in the wild for various purposes.

What he eventually came up with was not exactly path-breaking (Rothfels 2002b). For example, Sokolowsky characterized chimpanzees as “hopeful” and orangutans as “phlegmatic,” labels that had been attached to these apes already decades earlier, for example by Nissle. The German psychologist Oscar Pfungst criticized him for being too enthusiastic with respect to the mental abilities of apes because he did not adhere to the strict rules of experimentation. Sokolowsky had failed to create a test-situation and had merely observed. According to Pfungst, this dilettantish approach led to anthropomorphism, something that the new discipline of animal psychology was to avoid at all cost (Pfungst 1912, 203; Ash 1995, 151).

Both Nissle and Sokolowsky were marginal figures. They depended in different ways on big players such as Hartmann and Hagenbeck. They left few traces and it is telling that the dates of their deaths are unknown. Starting in 1921 Sokolowsky had no permanent position. He may have slipped into poverty (Daum 2002, 392, 396, 511; Rothfels 2002b). His last publication dates from 1935 when he was nearly seventy years old and bears a telling title: *Was bedeutet die Kleintierhaltung für das* “Dritte

*Reich*”? (What does the keeping of small animals mean for the “Third Reich”?). It is a practical guide with a distinct nationalist subtext for anybody willing to keep sheep, goats, or poultry in order to foster the autarky of the German Nation (Sokolowsky 1935, 91). Both Nissle and Sokolowsky tried to use their observations made at zoos to establish a scientific reputation with very limited success. Their attempts to develop a kind of animal psychology smacked of anthropomorphism and were criticized or even ridiculed.

In the early 1900s there were two different approaches to study animal life in captivity. On the one hand scholars such as Oscar Pfungst and later Wolfgang Köhler in his research station in Tenerife tried to abstract from context in order to create ideal test situations. Only this would provide reliable insights into the intelligence of animals. On the other hand zoologists such as Sokolowsky insisted on the crucial importance of the *Lebensbedingungen*, the actual living conditions of the creatures under study, focusing on their behavior, diet, “social needs,” and ecology. Yet at the same time Hagenbeck’s scientific assistant was well aware of the limitations of his own observations in Stellingen. Despite the pretense of the Tierpark in recreating natural habitats, the animals remained zoo animals. Sokolowsky concludes by saying that it would be most desirable to observe apes in the wild (Sokolowsky 1910, 67).

## 5. The intelligent Mr. Sutton and the motherly Mr. Seidel – Zookeepers

In Bram Stoker’s *Dracula*, a journalist interviews the keeper Thomas Bilder about the escape of a usually quiet wolf from his enclosure at the London Zoo (the wolf is summoned by the vampire). Bilder is portrayed as an authority in his own right, he “knows the animals from experience”: how they feel, what they need, and what is bothering them. At the same time the keeper is characterized as a simple man, speaking a thick dialect. He only confides in the reporter after receiving some money (Stoker 1983, 136–140, quotation from page 139).<sup>1</sup>

Unfortunately we know little about nineteenth-century zookeepers in real life. Initially some of them had been running itinerant menageries. When a zoo bought such a collection of animals they often took on their former owner as their keeper. In the Jardin des Plantes in Paris in the early nineteenth century, keepers even conducted breeding experiments without any instruction from their superiors, as the professors complained (Burkhardt 2008, 119). Matthew Scott, the keeper of the famous elephant Jumbo in the London Zoo rose to considerable fame in his time. The zoo and its director Abraham Dee Bartlett depended entirely on the quite headstrong and renitent Matthew Scott to care for and control Jumbo (Chambers 2007). Yet such a well documented case is the great exception. Mostly sources only tell us how many keepers were employed in a zoo, how much they earned, and whether they violated the

<sup>1</sup> I thank Conevery Bolton Valencius for this reference.

rules. They received no formal training until later in the twentieth century. Rather, the keepers were trained on the job (Heindl 2006, 97–115; Wessely 2008, 63–66). Despite their lack of training and their low social standing the keepers could be an important source of information on the behavior of zoo animals because they observed them every day and over long periods of time. For example, in order to determine the gestation period of a certain animal it was necessary to know when they mated. Thanks to a keeper at the Prater zoo in Vienna, the naturalist Ernst Marno claimed that he had determined the gestation period of two marsupials, the Tasmanian tiger and the kangaroo rat (Marno 1869a, 1869b).

We may glean hints of the importance of keepers for acquiring knowledge about animals by considering a puzzle which vexed naturalists throughout the nineteenth century and beyond: How does the tiny newborn kangaroo – it only measures a few centimeters – get from the vagina of the mother into the pouch? The zoo provided the opportunity to find out by observation, at least in principle. The French naturalist Étienne Geoffroy Saint-Hilaire tried his luck in the Jardin des Plantes in Paris in 1826 (Geoffroy 1826). In 1832, Richard Owen went beyond mere observation. The British naturalist assembled eight kangaroos at the London Zoo and paired males and females. He wished that “every endeavour will be made to clear up this part of the problem *ex visu*.” Yet the keepers in charge failed to observe the actual act of birth despite repeated efforts, much to Owen’s annoyance (Owen 1833, 132; Åkerberg 2001, 185).

A similar incident occurred at the Berliner Zoologische Garten. One evening in August 1847, a keeper informed the inspector Theodor Leisering about the strange behavior of the kangaroo, licking her genitals and putting her head in her pouch. Leisering, trained as a veterinary, suspected that a birth had just taken place (Leisering 1849). He had the pouch observed and after three weeks it started to swell up. He conceded that it must have been very difficult for the keeper to spot something as tiny as the kangaroo embryo. And he praises him as reliable, a “very able, sharp observer” and “free of prejudice.” Yet Leisering adds in a somewhat patronizing way: “The keeper was not aware of the importance of the entire act. Therefore he did not pay as much attention as would otherwise have been the case” (*ibid.*, 32; Frädriich and Strehlow 1994, 168). It comes as no surprise that sixty years later Sokolowsky admitted to have learned a lot from a keeper at the Stellingen Zoo named Schroeder about the behavior of apes (Sokolowsky 1908, 15) while Pfunst singled out keepers as unreliable observers (Pfunst 1912, 200).

Charles Darwin was anything but condescending towards keepers. One of his many talents was his ability to tap certain sources of information in a more fruitful way than other naturalists. He, for example, was very much interested in the work of animal breeders and beekeepers. As Darwin’s biographers put it: “Most naturalists disdained pigeons and poultry. Science was not done in the farmyard” (Desmond and Moore 1994, 426). In the same vein, he did not hesitate to converse with the keepers at the London Zoo. They told him that kangaroos “fight by scratching with their fore-feet and by kicking with their hind-legs; but they never bite each other” and that

rhinoceroses “do not draw back their ears, like horses and dogs, when feeling savage” (Darwin 1965, 113). Darwin considered a certain “Mr. Sutton” particularly able and trustworthy. He specifically instructed him to observe chimpanzees, orangutans, and other animals for him. Darwin gave this “intelligent keeper” due credit and mentioned him nearly a dozen times in *The Expression of the Emotions in Man and Animals* (1872). Without the input from the zoo, i.e. the observations of Darwin and the keepers, the two chapters in the book dealing exclusively with the expression of animals would have been seriously lacking in material (Voss 2005, 239–241).<sup>2</sup>

At the very same time as Darwin’s research in the early 1870s, the Aquarium in Berlin hosted Molly, a chimpanzee who made headlines because of her intelligence and “human” behavior. According to Brehm, director of the Aquarium at the time, this was in part due to her keeper, a certain Mr. Seidel. Thanks to his “motherly tenderness,” the ape took to her keeper in a way Brehm had never seen before. Brehm also praised Seidel for assuming the existence of a kind of capacity to reason in Molly and for treating her in a way educators treat a “friendly child.” The keeper taught her table manners, including eating with cutlery and toasting with his wine glass with the people sitting next to him (Brehm 1873, 82f). This rather sounds like training for a circus and it comes as no surprise that Brehm was amongst the authors singled out by Pfungst for misinterpreting his observations; to train an animal the way Seidel trained Molly invalidated all conclusions drawn from it (Pfungst 1912, 200, 203).

Thus what was going on at the Berlin Aquarium was quite different from what was happening at the same time at the London Zoo. Yet in both cases the human-animal boundary was under exploration. How human an ape was and how human it could become in captivity was widely discussed at the time. When Theodor Herzl (the famous Zionist) described the intimate relationship of the chimpanzee Maya and her female keeper in the Prater Zoo in Vienna it seemed to him “that they were of the same species” (Herzl [1897] 1911, 155f). Alois Kraus too mentions this apparently symbiotic relationship: Maja had lived for many years “day and night in company with her female keeper . . . so to speak *en famille*” (Kraus 1906). Both Herzl and Kraus seem to at least tacitly imply that a woman was more “apt” to form that kind of intimate bond. Most keepers at the time though were men.

I could not find out more about Mr. Sutton or Mr. Seidel, not even their first names. Yet even with the little information at hand, it seems safe to say that keepers were more than mere observers, reporting the time of mating or the way a birth took place. Provided the naturalists entrusted them with certain tasks, they could put quite different talents to work. While Sutton was a very attentive observer of the behavior of a whole variety of animals, Seidel obviously, excelled in forming an empathetic relationship with a chimpanzee.

<sup>2</sup> The standard biographies of Darwin do not mention Sutton (see Desmond and Moore 1994, and Browne 2003).

## 6. The talented Mr. Wolf and the multi-talented Mr. Leutemann – Animal Painters

David Friedrich Weinland pointed out that not only the naturalist but also the artist would benefit from live animals at the zoo. Here the artist can study the animals as nature created them and does not have to be afraid of being misled by the “twisted forms” of dead animals (Weinland 1860–61, 186). In a similar vein, a reviewer of Carl Vogt’s *Die Säugetiere in Wort und Bild* (Mammals in word and image) (1883) praised the work of the animal painter Friedrich Specht: “One sees clearly that these drawings have not been executed in view of stuffed hides at museums but through the study of the living animal. We owe it to the zoological gardens that German animal painting has risen to such heights” (Anonymous 1884, 29). To contrast stuffed specimens from museums with live ones from zoos is a trademark of the rhetoric of the reform movement. It is true, painters did indeed make ample use of the new opportunities provided by the zoos to the point that the crowds of painters in front of the cages became the object of ridicule (Artinger 1995, 107; Voss 2005, 233f). Already in the early nineteenth century Theodore Géricault and Eugène Delacroix visited the Jardin des Plantes but also itinerant menageries. Yet at the same time they came to the dissection table of Georges Cuvier at the Muséum d’histoire naturelle to study the anatomy of “fresh” lion cadavers (Artinger 1995, 106). To combine the study of dead and living animals was rather common for many animal painters throughout the nineteenth century (Voss 2005, 233f). After all, living exotic animals were still rare, and corpses were more easily studied up close and in detail. In this sense, and as Lynn Nyhart has shown, museums and taxidermists were just as much part of the reform movement as the zoological gardens.

Depictions of animals became a thriving genre in the nineteenth century and many animal painters can be considered an integral part of the reform movement. Joseph Wolf and Heinrich Leutemann were arguably two of the most important ones. Arriving in 1848, the German painter Joseph Wolf (1820–1899) spent nearly all his adult life in London. For half a century he lived near Regent’s Park and paid innumerable visits to the zoo. In 1861 he became a “resident artist” of the Zoological Society (who ran the zoo) and contributed more than 340 lithographs to its *Proceedings*. He was friendly with the inspector Bartlett and knew many of the keepers, who informed him about new “arrivals” or interesting occurrences.

The zoo was not his only workplace. He regularly went on excursions to see animals in the wild and he also drew animals from hides or carcasses. When Richard Owen received a badly conserved corpse of a gorilla in 1859, presumably the first one ever to come to Europe, Wolf was present and was commissioned to draw a living gorilla (Schulze-Hagen 2000; Voss 2005, 235–238). He had a reputation for being an astute observer and studied the anatomy of animals in order to render them as realistic as possible. It was therefore no coincidence that Wolf was among the animal painters who Darwin recruited to illustrate his *Expression of the Emotions in Man and Animals*.

Eventually Darwin included two drawings by Wolf of a *Cynopithecus niger* (today called *Macaca nigra*/Celebes Crested Macaque) in his book. They were supposed to show that the monkey was filled with anger and pleasure. It has been argued that Wolf's lively portraits of monkeys influenced Darwin's own perception (Schulze-Hagen 2000, 201; Voss 2005, 240).<sup>3</sup> For Darwin, man ceased to be the only laughing creature.

Wolf never left Europe but painted herds of gazelles and gnus grazing in the African savanna, North American wapitis trailing through the snow and swirling sea bird colonies. "His animals display complex modes of behaviour; they search for food, display, groom and preen themselves, look after their young, or gather in groups. We see males fighting over females and territory, or being pursued by predators." For Karl Schulze-Hagen these accurate depictions of animal habitats "illustrate behavioral and ecological interrelationships" long before they were formulated theoretically (Schulze-Hagen 2000, 201).

Heinrich Leutemann (1824–1905) worked as an illustrator for *Die Gartenlaube*, *Illustrierte Zeitung* and *Über Land und Meer*, highly successful magazines with a six-figure circulation which were literally read by millions.<sup>4</sup> Soon he also wrote the accompanying articles for his drawings himself. Many of his drawings were published in popular science magazines such as *Die Natur*, in schoolbooks and encyclopedias, or served as wall charts in the classroom. Leutemann was not only a painter and a journalist. Leutemann was a close friend of Carl Hagenbeck and inspired him in 1874–75 to start his famous or rather infamous ethnographic shows at zoos (Leutemann 1887, 48; Heck 1894, 437; Hagenbeck 1909, 80). For a couple of years, itinerant menageries were his favorite objects of study (see e.g. Leutemann 1860). Then the new train lines enabled him to travel easily himself and to visit many zoos. From his home in Leipzig he went not only to Berlin, but also to Hamburg and to Amsterdam in order to study the behavior and expressions of animals. Leutemann insisted on the living animal as the only proper way of studying and praised the opportunities the zoological gardens offered, e.g. to observe how the animals changed considerably while aging (Leutemann 1872, 786).

Due to his constant traveling and his close contact with Hagenbeck, Leutemann had probably seen more living chimpanzees than most other people in Germany, including most naturalists. And as a painter he had an eye for specific bodily features. Already on his first visit with Mafuka right after her arrival in August 1873 he remarked on her peculiar appearance, i.e. the color of her face. Unlike all the other chimpanzees he had seen, she was nearly entirely black. Therefore he suggested that this pigmentation, also to be found on the flesh-colored pigmentation of her hands and feet, might be a

<sup>3</sup> Animal painting is not a well researched topic. There are three insightful monographs on zoo painting in the late nineteenth century (Artinger 1995; Kaselow 1999; Hardouin-Fugier and Dupuis-Testenoire 2001) yet they do not ask if and how naturalists and animal painters collaborated. This issue is addressed by Voss (2007, 284–286).

<sup>4</sup> There is virtually no secondary literature on Leutemann. Heck (1894) is interesting for the perspective of a contemporary. Rothfels (2002a) mentions Leutemann several times as a supporter of Hagenbeck. Stach (2004) praises him as an author of children's books.



sufficient reason for a naturalist to consider her a different species (Leutemann 1874, 64). But it took nearly two years before Mafuka’s black face was put forward as the main argument for her being a gorilla (see above).

Leutemann was also very apt at describing her behavior. Owing to the medium he wrote in he did this in a humorous way, constantly alluding to the alleged relationship between apes and humans. He stressed both her “childish” traits as well as her talent for imitating what she had seen humans do. Leutemann also participated in a kind of improvised experiment together with the director Albin Schöpf in order to see if she behaved differently with “black” people, in this case a chimney-sweeper (Leutemann 1874, 66).

In a second article that appeared two years later, he noted what Mafuka had learned – e.g. to use her right hand instead of her left one. He thought that she had some form of conscience but not yet consciousness (Leutemann 1876, 95). All these questions were much debated at the time by naturalists. Both his articles were accompanied by an illustration the size of a magazine page. The illustration from the second article consists of eighteen smaller drawings around a central one, literally sketching some of the different activities that Mafuka engaged in (ibid., 92). Some of them are rather humorous showing her pulling a boot off her keeper or wearing a bowl as a hat. Yet Leutemann also visualized the way she held objects, the positioning of “hand” and “foot,” the knuckle walking, a “quick run on an even surface,” and mental states such as “peace of mind” and “agitation.”

His articles were primarily journalistic to entertain the reader. Yet they were also first-hand documentations of animal behavior, both in written form and visualized, e.g. for which purposes the chimpanzee used her “hands” and feet. Darwin was more systematic and precise in his descriptions. Yet if we compare the images of monkeys his *Expression* with Leutemann’s drawings we find some striking parallels. The protruding of the lips of a chimpanzee was depicted both by Leutemann and Thomas Wood, another animal painter recruited by Darwin for his book. The legends read “agitation” (Leutemann) and “sulky and disappointed” (Darwin). Leutemann also captured Mafuka expressing “peace of mind” while one of the two drawings of Wolf shows the *Cynopithecus niger* “in a placid condition.” Both times the lips of the animals are firmly closed.

Leutemann was not the only animal painter using this form of representation. Nissle’s article in the *Zeitschrift für Ethnologie* was accompanied by a double page of seven of Gustav Mützel’s drawings of Mafuka (Nissle 1876b, figures). One showed the knuckle walk and one the protruding lip. Yet unlike Darwin, no German naturalist followed up on this. They were too busy determining Mafuka’s species. Julia Voss calls the animal painters – in reference to Steven Shapin’s term – the “invisible technicians” of zoology and early ethology (Voss 2005, 241). There is little information in the sources on the actual interaction between naturalist and animal painter in the case of the zoo. Wolf was on good terms with Owen and Darwin. There is no indication that he quarreled with them, differences in opinion he seems to have kept to himself. Only many years

later he told his biographer: “I never believed that the fellow was laughing, although Darwin said he was” (Palmer 1895, 193). Leutemann’s visual language focused more on Mafuka’s movements and actions than on minute anatomical details if compared with the drawings by Mützel. That might explain what Ludwig Heck wrote about Leutemann on the occasion of his seventieth birthday: “‘He makes the animal how he wants them and not how I want them,’ a well known scholar of animals (Thierkundiger) supposedly once complained” (Heck 1894, 437).

## 7. The well-known Mr. Darwin and the unknown Mr. Ulrici – Visitors

Arguably the most famous visitor of zoos in the nineteenth century was Charles Darwin. As mentioned above he used the zoo for his research on the *Expression of the Emotions in Man and Animals* around 1870. Yet his first visits to the London Zoo can be traced back to the 1830s. His encounter with the orangutan Jenny in March 1838 has often been told and has by now become a standard element in popular narratives about how Darwin “came up” with the theory of evolution. The famous passage from his notebook reads: “Let man visit Ourang-outang in domestication, hear its expressive whine, see its intelligence when spoken, as if it understood every word said – see its affection to those it knows, – see its passion & rage, sulkiness & every action of despair . . . then let him [man] dare to boast of his proud preeminence.” A few pages (and weeks) later he stated: “More humble and I believe true to consider him [man] created from animals” (Darwin 1987, C 79, C 196f). The immediate experience with the still very rare apes and the much more common monkeys in zoos did highlight the likeness of man to his “hairy cousins.” In particular after the publication of Darwin’s *Origin of Species* in 1859, with the debate on human origins in full swing, zoos provided a space of resonance or one might even say a visualization of evolutionary theory for the public at large (Hochadel 2010).

Darwin even used the London Zoo as a kind of laboratory. Between 1856 and 1867 he conducted three different kinds of experiments there: In 1856 he brought “dead sparrows, their crops stuffed with oats, and fed them to a bateleur eagle and snowy owl, whose regurgitated pellets he then took home.” He planted those pellets and to his great pleasure they germinated: Darwin believed that he had shown another mechanism for the distribution of seeds over long distances (Desmond and Moore 1994, 445). In 1862 Darwin asked inspector Bartlett to carry out selected crosses between the Himalayan, a certain type of domestic rabbit, and other breeds in order to study inheritance patterns in the coloring of their fur (Browne 2003, 204). In 1867 he “had the bower birds in London zoo given a choice of worsted to test their colour preference.” This was part of his argument with the Duke of Argyll on what caused variation, making Darwin think more about sexual selection as an explanation (Desmond and Moore 1994, 545).

Surely, Darwin was not an “ordinary” visitor. His ties with the Zoological Society, his close relationship with inspector Bartlett and his growing reputation enabled him

to carry out experiments at the zoo and, as mentioned above, to instruct keepers to observe animals as part of his research program. It is likely that in the course of the nineteenth century there were similar cases of naturalists living near a zoo using the opportunities that presented themselves to carry out investigations, even if they did not have any official position. It might well be that many investigations were not recorded or the records were not preserved. The annual *Proceedings* of the Zoological Society of London for example recorded only two “planned” experiments on living animals at the London Zoo in the entire nineteenth century: a feeding experiment with wildcats and Owen’s kangaroo experiment mentioned earlier (Åkerberg 2001, 184). The *Proceedings* do not mention Darwin’s investigations.

Yet unlike Darwin, whose activities, to put it modestly, have been well researched, little is known about other “ordinary” observers at the zoo. If Darwin were placed at one pole with respect to his degree of popularity, Emil Ulrici would be at the other. We know next to nothing about him, no dates of birth or death. He probably was a lawyer.<sup>5</sup> He lived in Dresden in the 1870s and claimed to have observed Mafuka nearly every day from her arrival. All that has emerged so far is a letter he sent in early December 1875 to Rudolf Virchow claiming that Mafuka was a hybrid between chimpanzee and gorilla. Virchow, one of the leading German scientists of his time and president of the Berliner *Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*, must have considered this letter a valuable contribution because he communicated its content orally at a meeting of the society and had it printed in its proceedings (Hartmann 1875b, 284).

Ulrici knew what the “anthropometrically” minded anthropologists in Berlin were looking for (Zimmerman 2001, chap. 4). In his letter he said nothing about the behavior of Mafuka. Yet he claimed to have achieved what Nissle had failed to do. Ulrici provided a detailed physical description from head to toe, including twenty measurements of different parts of the body. The measurements were in millimeters and purported to be very precise. Some of these were taken by Ulrici himself, others by director Schöpf. What is more, his quasi-permanent observation allowed Ulrici to spot changes in the physical appearance of the ape over nine months.

Ulrici tried to propagate his hybrid theory at the meetings of scientific societies in Dresden. Yet his greatest “impact” was his letter to Virchow. Only after the publication of this short piece (which only amounted to one page in print) did scholars start to take his theory seriously if only to oppose it. To print and discuss the theory of an unknown local naturalist was not unusual at the time. Anthropology had not yet been established as an academic discipline. The Berliner *Gesellschaft*, founded in 1869, was run by luminaries such as Virchow, Hartmann, and the ethnologist Adolf Bastian,

<sup>5</sup> Bibliographical research yielded two printed speeches of only a few pages in the field of ethnography that are probably by Ulrici (Ulrici 1867 and 1880). Ulrici lived in Dresden at least from 1868 until 1877. In this time span he moved house at least four times according to the *Dresdner Adressbuch*. In 1868 his profession is given as “private lawyer”; in 1871 he is simply called “privatus” (I thank the Stadtarchiv Dresden for this information).

but most of its members were amateur scientists (ibid., 47; Goschler 2002, 181f). The Berliner Gesellschaft depended on their support (if only to fill the meetings and provide a receptive audience) and their input in terms of the collection of material. This would have been mostly human bones or ethnographic objects. Yet in the 1870s, there were quite a few articles in the journal, the *Zeitschrift für Ethnologie*, and in the proceedings of the Berliner Gesellschaft which dealt with apes. Because of the heavily debated question of human descent, chimpanzees, gorillas, and orangutans were of great interest to anatomists and physical anthropologists.

Andrew Zimmerman has shown that the Berliner *Gesellschaft* despite its reliance on amateurs was nevertheless very hierarchical. Scientific questions were decided behind closed doors by anonymous committees made up of experts (Zimmerman 2001, 132). Yet there seem to have been exceptions. The debate about Mafuka's species spiraled out of control at least for a couple of months. This becomes evident if we look at who put forward the theories being discussed. There were eventually five different interpretations, the first one claiming that Mafuka was a chimpanzee, most loudly voiced by Bolau and seconded by Schöpf and A.B. Meyer. The second interpretation was put forward by Hagenbeck and buttressed by Nissle: She was a gorilla. Ulrici came up with a third possibility: a hybrid. Brehm, who at first had joined the gorilla faction, came up with a fourth interpretation: Mafuka might be a species of her own, which he provisionally called "Tschego". Hartmann eventually attempted a fifth interpretation: maybe chimpanzee and gorilla formed only one species, which showed enormous variation. In short, we have a zoo director, an animal dealer, an amateur, a science popularizer, and a university professor in one arena (Hochadel 2008a).

An animal that could be observed by anybody who bought a ticket to the Dresden zoo and whose images were readily available was difficult to contain. Nissle and Bolau at first exchanged their opposing views in newspaper articles (Nissle 1875; Bolau 1875). It was only after Mafuka's death that anatomists seized control again. But instead of withdrawing behind closed doors Hartmann and A.B. Meyer started to wrangle about who would get to study her remains. After the dissection, and in particular after the first real gorilla had come to the Aquarium in Berlin in the summer of 1876, the debate was finally resolved. Mafuka was again considered to be a chimpanzee. A.B. Meyer mounted both her skeleton and her hide in his Zoologisches Museum in the Dresden Zwinger (Meyer 1877).

## 8. All inclusive – professional and lay observers in *Der Zoologische Garten*

In dealing with people who observed animals at the nineteenth-century zoo, I have so far used the terms "professional," "layman," or "amateur scientist" sparingly and mostly in inverted commas. Thus I have tried to avoid approaching these diverse groups of naturalists with a dichotomy of layman or professional in mind. Historically, this dichotomy was just about to be constructed and at the time quite a few and even some

of the leading naturalists such as Darwin himself were self-educated. “Amateur” or “professional” were labels which practitioners of natural history put on themselves and others, e.g. Pfungst on Sokolowsky. These labels carried certain meanings and were part of a negotiating process. Who was entitled to say what about natural phenomena?

In order to learn more about these attributions, it may be helpful to leave the actual zoological gardens and browse instead through *Der Zoologische Garten*. The first issue appeared in 1859 and the journal soon became the “central organ” for the German-speaking zoo community (Bruch 1864, 1; Nyhart 2007; Nyhart 2009, 80). The monthly journal ran from 300 to 400 pages a year and still exists today. It features reports from German zoos but also from zoos all over the world. It abounds with extensive observations on animal behavior and nutrition, and reports on new arrivals, procreation efforts, and successes; births, deaths, operations, diseases, questions of classification, and new species.

The journal did more than just serve as a focus point for the emerging communities of zoo directors in Germany and abroad. Very different kinds of people, often with no immediate connection to zoos, sent in their observations of and experiences with animals: breeders, amateur scientists (very many of them ornithologists), animal painters, foresters, naturalist travelers, and people living in the European colonies in Africa or South East Asia – a cross-section of the German *Bildungsbürgertum*. The vast majority of contributors were school directors, teachers, and ministers. The “inclusive capacity” of the *Der Zoologische Garten* was remarkable. It soon became instrumental in forging a very diverse community of naturalists, nature lovers, and early conservationists from all over Germany even before the founding of the Reich in 1871 (Nyhart 2009, 80).

Roughly half of the articles in *Der Zoologische Garten* do not deal with zoo animals or the zoo itself. The spectrum of contributions could hardly be broader. They range from short notes to articles with a dozen or more pages. One finds anecdotes on how a horse saved a toddler or on how caring an ermine was about her offspring (Anonymous 1869). At the other end of the spectrum, there were highbrow discussions about the language of animals and their intelligence, for example by German zoologist Reinhold Hensel (Hensel 1869). The journal addressed topics such as biogeography, ethology, and the protection of species that were picked up only later by professional scientists (Rieke-Müller and Dittrich 1998, 266).

Occasionally, *Der Zoologische Garten* provided the stage for controversy. In 1870 after having read Alfred Russell Wallace, a certain A. Glaser, a teacher from Worms, claimed priority for having discovered mimicry in butterflies, referring to an article he published back in 1848 (Glaser 1871). A. J. Jäckel, a minister from Windsheim argued with the eminent ornithologist Bernard Altum about the diet of the barn owl. Altum was among the first to propose the concept of territory in his research on birds in Central Europe in his book *Der Vogel und sein Leben* (The bird and its life) of 1868. Jäckel had collected 6512 pellets of the barn owl: “These are results of diligent research, and I refuse any criticism of them” (Jäckel 1874). These contributors often introduced

themselves as “dilettante,” thereby modestly assuming a lower rank. They reported that they had searched the scholarly literature on the topic in vain before claiming a remarkable observation or discovery (for example, Meyer 1874). Occasionally, a certain undercurrent, a tension between “dilettantes” and professional naturalists surfaced.

The Swiss naturalist Hermann Fischer-Sigwart, for example, was eager to rehabilitate the common frog against “accusations” that it was a hunting fish. “One might ask at first, how a dilettante should stand up against men of science?” he asked – and answered: Such scholars might tower over him but they cannot claim such an intimate acquaintance with the animal itself. He had an entire “colony” of frogs living “under his roof” and had observed them for years (Fischer-Sigwart 1884, 23). The “dilettantes” oscillated between deference and self-confidence. They claimed personal, intimate, and long-lasting experience with the animals in question. And they got “touchy” if their insights and hard-won results were questioned by the “professionals.” Occasionally, they polemicized against those who tended towards theories lacking “immediate observation” (Müller 1868, 345).

Both the Berliner Gesellschaft and *Der Zoologische Garten* relied heavily on the collecting efforts and observations of non-professionals. Yet whereas the society was tightly controlled by a small circle of scholars, the journal was remarkably open to contributions from outside. Very little is known about the editing process of the journal, but the heterogeneity of the articles indicates that there was little if any censorship. On its pages the “dilettantes” could pursue their interests, however idiosyncratic, and sometimes even took issue with the “professionals.” Thus a dichotomy on two levels emerged: with respect to their occupation, the “dilettantes” were deferential toward the “professionals.” Yet with respect to their expertise, they at least implicitly claimed to be “experts” due to their scrupulous and intimate observations of animals, thus putting themselves above the “theoretical” approach of the “professionals.” In this respect *Der Zoologische Garten* was truly a strong voice of the reform movement.

The fact that the journal despite its name and its original purpose (to cover matters relating to zoological gardens) only a few years later dealt with natural habitats in Central Europe as well is a clear indication that the reform movement was fluid and pursued its agenda in different spaces. Individual actors such as Heinrich Leutemann praised the zoo as an ideal place to study animals but also published articles in *Der Zoologische Garten* on domestic animals such as “singing” mice (Leutemann 1862). German zoologist and publicist Philipp Leopold Martin championed both taxidermy and zoological gardens, pressing for decades to use both media to render animals life-like (Nyhart 2009). It may seem contradictory to us today to deal with “dead” or “captive” animals while proposing to study animals in their natural habitat. Yet for Martin and many of the contributors of *Der Zoologische Garten* these different modes of representation were rather complimentary in depicting the way of living (*Lebensweise*) of these animals, both domestic and exotic.

## 9. Conclusion: All too close – the limits of intimate knowledge

What can be said after these five double portraits sketching different kinds of observers in the nineteenth-century zoo? Their observations were strongly shaped by the institution of the zoological garden itself. These observations were not always, but often owed to coincidences, opportunistic, ad-hoc and without a clearly formulated research agenda. Much of the “interaction” with the animals was shaped by practical considerations. Often the primary aim was to understand animals in the specific context of the zoo: how to keep, nourish, breed, and acclimatize them. How to cure them and how to extend their life span. And finally, how to present the animals to the audience more “naturally,” that is to say in a more appealing way.

For the reform movement the zoo was one of several sites to pursue their agenda to study the entire animal and their *Lebensweise*. Yet certainly not all the observations made in the zoo focused on the behavior of the animals. Ulrici and to some extent Nissle as well focused on the physical features of Mafuka. They took or tried to take measurements of the body, looked at the dentition, the coloring of the face, and so on. We know very little about Ulrici but from his letter to Virchow it seems obvious that he knew what his peers at the Berliner Gesellschaft were most interested in. The Berliner Gesellschaft with its focus on anatomy represents, in a sense, the traditional academic research program that was rather antithetical to the goals of the reform movement. After all, the Mafuka debate was a debate about taxonomy. Even Brehm, one of the most prominent advocates of the reform movement, dedicated three pages to Mafuka in the second edition of his *Thierleben* yet restricted himself to merely describing her physical features (Brehm 1876b, 79–82, similarly in Brehm 1876a, 47). As regards her behavior he referred the reader to what he had said on the previous pages about chimpanzees in general. It was only in the course of the argument that people such as Heinrich Leutemann, Gustav Mützel, and others observed, described, and visualized in great detail her behavior. Yet these observations hardly played a role in determining her species. They were a spin-off of the shift of attention to Mafuka. Having said that, some of the observers at the zoo did pursue a specific research program, most notably Frédéric Cuvier, but also Charles Darwin and Alexander Sokolowsky. They depended on the availability of certain animals and the fact that these animals’ lifespans were often short hampered their efforts.

A further limitation of the zoo that was in the mind of the nineteenth-century observers was the fact that they were looking at animals in cages. Naturalists had been debating since the eighteenth century about how far the observations made in royal menageries and later in zoological gardens could be of value. Many scholars, most prominently Buffon himself, held that animals would not behave naturally in captivity (Buffon 1770–1786, II, 202). This view was not unanimously shared and challenged most forcefully by Frédéric Cuvier (Cuvier [1825] 1827, 318). He held the post of *garde* (approximately the position of inspector) at the Jardin des Plantes

from 1803 to 1838 and “proceeded to develop the most impressive program of animal behavior studies formulated in the first half of the nineteenth century” (Burkhardt 1999, 492). Yet the notion of the fundamental deficiency of observations made in the zoo continued to exert a strong influence throughout the nineteenth century and beyond. As mentioned above Sokolowsky discarded his own – from our present day perspective highly interesting – observation of tool use by capuchin monkeys.

Possibly the most problematic limitation of the zoo was the fact that it had become a public space. On the one hand this enabled very different kinds of people to study live animals at the zoo as we have seen. Yet on the other hand it was argued that the open access to the zoo at the same time made systematic and continuous observation difficult if not impossible. For many contemporaries it seemed obvious that in the last third of the nineteenth century the public and its demand for attractions and entertainment had come to dominate the zoo. “Heterogeneous collections of animals, exhibited for the amusement of people, are wholly unsuited to the purposes of investigation in time, place and character,” decreed the American zoologist and early ethologist Charles Otis Whitman in 1902: The investigator “must have complete and permanent control of his quarters and the forms he is to study, and above all, *complete isolation from the public*” (Whitman 1902, 211; cf. Burkhardt 1999, 498; emphasis in the original)

When the proponents of the reform movement stressed the importance of focusing on living animals, they always had the general public as an audience in mind. For them the study of the behavior of animals went hand in hand with the instruction and the moral elevation of the visitors of the zoo. Yet as the nineteenth century wore on these two goals seemed to be more and more incompatible. Naturalists such as Whitman called for the establishment of zoological research stations. In his case this did not materialize (Kohler 2002, 46f). More successful were attempts to study primates outside of zoos. In the first decades of the twentieth century several research stations were deliberately founded in closed-off spaces and often in tropical or at least subtropical locations (Heineke and Jaeger 1993). To give but one example: In 1912 the Prussian Academy of Sciences opened a specifically designed research station on the island of Tenerife where Wolfgang Köhler soon afterwards conducted his path-breaking studies on the intelligence of chimpanzees (Ash 1995, 148–167).

So one may argue that animal science and the nascent disciplines of ethology and primatology had to leave the zoo to become fully-fledged and widely recognized disciplines. Yet this seems too straightforward a narrative. Rather than a complete shift from the zoo to research stations, other spaces to observe wild animals multiplied at the beginning of the twentieth century including the field itself. Yet the zoo continued to provide opportunities to study animals that were difficult to match elsewhere. We already mentioned Oskar Heinroth who became an assistant at the Berliner Zoologische Garten in 1904. He used the large assembly of water birds at his disposal to study their behavior (Heinroth 1971, 89; Klös, Frädriich and Klös 1994, 419; Burkhardt 1999, 500). It was the specific infrastructure provided by the zoo, the numerous small cages and aviaries, but also the meadows and ponds that enabled Heinroth to keep and to



observe a large number of different species of birds over a long period of time (Frädriich and Strehlow 1994, 172f). Heinroth is nowadays considered an important figure in early ethology and was arguably the most important mentor of Konrad Lorenz. Two years after Heinroth, in 1906, Anton Portielje (1886–1965) became the scientific assistant of the Artis Zoo in Amsterdam. And the Dutch ornithologist too made ample use of the opportunities provided for observation in his pioneering work on the mating behavior of exotic birds published in the 1920s (Smit 1994; Burkhardt 1999, 500; Burkhardt 2005, 192). The zoo as a place for research in the twentieth century is beyond the scope of this essay. Yet science did certainly not leave the zoo, suffice it to mention the research of Desmond Morris in the London Zoo in the 1950s and 1960s, the study of “chimpanzee politics” of Dutch primatologist Frans de Waal in the Arnheim Zoo around 1980, or more recently the opening of “Pongo-Land” in the Leipzig Zoo, that serves as a research facility for the nearby Max-Planck-Institute for Evolutionary Anthropology but at the same time allows the visitors of the zoo to observe all four kinds of the greater apes.

The crucial difference to the nineteenth century is of course, that Morris, de Waal and many other people doing research at the zoo all have their degrees in zoology and cannot be described as “lay observers.” In sketching the broad spectrum of people observing animals at the zoo more than a hundred years ago, it has become obvious that they were driven by very different motivations. It seems difficult to disentangle strictly “scientific” observations from other kinds of observation. Questions of taxonomy were also questions of evaluating animals in financial terms. Large groups of exotic animals provided the opportunity to spot a new species and thereby to boost one’s scholarly reputation. The case of Mafuka is only one spectacular case of this enmeshment of motivations.

Although the observers we discussed were very different, it is typical for most of them to act in different roles, and to talk to different audiences ranging from the broad public to interested lay people and experts (Brehm, Nissle, Leutemann, Hagenbeck, Sokolowsky). Journalists and, in particular, animal painters were primarily interested in texts and images that would appeal to a broad public. Yet artists such as Wolf and Leutemann went far beyond merely entertaining their readership. They helped to shift the scientific focus from anatomy and morphology to behavior and “animal psychology.” The zoo offered ample opportunities for very different people to pursue their specific interests and to use their individual talents and capabilities to observe animals in a fruitful way. Maybe even more importantly, the zoo became a place where observers of animals could interact. Naturalists could draw on the help of directors, inspectors, and keepers or recruit painters to strengthen their arguments. Zoo directors employed taxonomists to assess their stock (Hagenbeck-Sokolowsky) and helped “ordinary” visitors in their research on living animals (Bartlett-Darwin and Schöpf-Ulrici). The animal painter Gustav Mützel started to collaborate with Brehm in 1872 and became the main illustrator for the second edition of the *Thierleben*. Both actually traveled together throughout the 1870s to visit zoos in Germany

and the Netherlands in order to study exotic animals (Müller-Liebenwalde 1893, 326).

Yet the actual impact of “scientific” observations at the nineteenth century zoo was, one may argue, very limited. Frédéric Cuvier’s ambitious research program at the Jardin des Plantes came to a sudden halt with his death in 1838, “his observations remained scattered and his synthesis unfinished” (Burkhardt 2001). What Leutemann, Sokolowsky, Ulrici and many other “lay observers” communicated to their respective audiences did not trigger much research, at least not in any direct sense. Even Darwin’s book on the *Expression of the Emotions*, partially based on observations on zoo animals, although initially a commercial success, was more or less ignored by biologists until the late twentieth century.

There were several reasons that these insights and ideas were not or only to a small degree picked up by “professional researchers.” Some of the observers in the nineteenth century zoo had no voice of their own, if we think of the keepers Sutton and Seidel. Or their own voice was too weak and depended too much on the support of bigger players (Ulrici, Nissle). The media they used were ephemeral, meant to entertain and not to gather new knowledge (Leutemann) or considered all too popular or anthropomorphic (Sokolowsky). They produced art, nice to look at and even useful for illustrating academic publications (Wolf). Yet even the most insightful images do not immediately translate into a research agenda. Their interest in studying animals was too obviously motivated by economic considerations (Hagenbeck). Or they distrusted a “theoretical” approach altogether (Kraus). And maybe most importantly, the kind of observations, experiments, and interpretations conducted and put forward by these non-professionals did not meet the rigorous standards formulated and demanded by academic scientists. In this sense, as we have seen, the work of Nissle and Sokolowsky rather served as a contrast foil, as a bad example of how *not* to do science. This kind of demarcation helped to strengthen the nascent professional identity of new disciplines such as experimental psychology and ethology. The zoo with its numerous limitations, so it seemed to scholars such as Whitman and Pfungst, was simply the wrong place to gain reliable knowledge about animals.

Yet claims by scholars to be more “scientific” than other observers may be considered first of all a rhetorical strategy to discredit rival epistemologies, as historians of science have shown time and again. In the case of the lay observers of exotic animals in zoos one common feature stands out, and that is their claim of intimate knowledge of the animal. They continuously stress their first-hand experience based on long-term observation and interaction with animals. Brehm who had indeed had the opportunity to observe numerous chimpanzees in the Hamburg Zoo and later in the Berlin Aquarium “immediately” knew that Mafuka was not a chimpanzee when he saw her first on 28 August 1875 (Brehm 1875, 392; Brehm 1876a, 47; Brehm 1876b, 79). His first word on the Mafuka debate was a letter he sent in September 1875 to *Der Zoologische Garten*. As he explained in a lengthy article that appeared the following year in *Die Gartenlaube* he first wanted to communicate his results to

*Fachmänner* (experts) before voicing his opinion in public. For him *Der Zoologische Garten* was a “wissenschaftliche Zeitschrift” (scientific journal). In other words Brehm mobilized both the authority of his peers and his intimate knowledge of apes in order to substantiate his claim as regards the species of Mafuka (Brehm 1876a, 47). In this case Brehm clearly took advantage of his “multiple” roles as a zoo director, popular science writer, and zoologist marshalling different media to maximize the impact of his interpretation.

The example of the articles from *Der Zoologische Garten* showed that this epistemological tension was by no means restricted to lay observers in the zoo. Lay observers of wild life in German fields, forests, and ponds too claimed to possess a specific intimate knowledge of animals and often contrasted their practical experience with the merely academic or theoretical knowledge of scholars. These scholars in turn maintained that the observations in question were too personal, mere anecdotes, owed to coincidences and hence could not be generalized. Yet as Robert Kohler has shown for the case of the United States it was precisely this “personal” or “local” knowledge of so-called amateurs, of breeders, farmers, and hunters that proved indispensable in charting the flora and fauna of large parts of the country in all its (bio-)diversity (Kohler 2006).

This conflict between intimate and personal “knowledge” with the object of study versus depersonalized, analytical and “objective” methods recurs *mutatis mutandis* in other disciplines and contexts. In an essay first published in 1937 Konrad Lorenz praised “animal keepers, biologically trained amateurs and observers in the field” for the understanding of instinct in animals and scolded “American laboratory scientists” who lacked the “practical” knowledge of the former (Lorenz [1937] 1966, 284f; cf. Burkhardt 2005, 266f).<sup>6</sup>

The nineteenth-century zoo remains an intriguing place. And the reason for this is that it was such a hybrid space. It allowed very different kinds of people to study the exotic animals hosted there. It made scientific observations of all kinds possible while putting serious constraints on them too. Yet as we have seen other scientific agendas, in particular taxonomic and anatomical questions were pursued there just as well. Nevertheless the zoo was certainly an important part (and space) for the reform movement in natural history. What Lynn Nyhart has labeled the “biological

<sup>6</sup> Occasionally even scientists whose work was laboratory-based claimed some kind of intimate acquaintance with their biological material as prerequisite for new insights. Judy Johns Schloegel has argued this in the case of the American geneticist Tracy Sonneborn and his work on the single-cell organism *Paramecia*: “Sonneborn maintained throughout much of his career that his investigative approach was the pursuit of ‘intimate knowledge,’ gained through ‘intimate acquaintance’ and ‘intimate familiarity’ of *P. aurelia*.” Sonneborn considered this “method of knowing” an “epistemically valuable means of obtaining scientific knowledge” (Johns Schloegel 1999, n. 12). And more famously Barbara McClintock’s “feeling for the organism” has become a shorthand for her personal approach to genetics, “listening” to the material (Fox Keller 1983, 198) that at first made it difficult for the scientific community to accept her results and in the end won her the Nobel Prize (I thank an anonymous referee for pointing this out to me).

perspective” yielded fruit. “Although not considered especially scientific in retrospect, practical naturalists working with living animals in and out of zoos in the later nineteenth century contributed (literally) volumes of information about animal habits, behavior, and basic living requirements – interests that in and of themselves, though not systematized, constituted an enormous expansion in explicit attention to living animals and thereby contributed directly to biological knowledge” (Nyhart 2009, 108). The focus on the behavior of animals and their relationship with their environment, the demands for the protection of wild life and their habitats favored and fostered a “holistic” approach to the study of nature. This “holistic” approach was driven in part by practical questions of animal keeping, by financial motives of maximizing revenues, by the wish to entertain readers through depictions and descriptions of animal behavior as well as the motivation to gain an intimate and personal knowledge of certain zoo animals, however anthropomorphic or unscientific this might have been judged to be. The shift toward the living animal as a worthy object of study owes much to these “lay observers” of the nineteenth-century zoo and contributed to the formation of ethology and ecology as scientific disciplines in the first decades of the twentieth century.

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