Red Foxes in the Filing Cabinet: Günter Tembrock’s Image Collection and Media Use in Mid-Century Ethology**

Sophia Gräfe*

Summary: This paper considers the epistemic career of visual media in ethology in the mid-20th century. Above all, ethologists claimed close contact with research animals and drew scientific evidence from these human-animal communities, particularly in public relations. However, if we look into the toolboxes of comparative behavioral biologists, it becomes evident that scientifically valid research results were primarily obtained by experimenting with model images. These visual specimens tell a technical story of the methodological requirements in behavioral science necessary to bridge everyday observations between the laboratory and the field. By neutralizing individual traces of animal bodies as well as their observers, they prompted the abstraction of ethological hypotheses. The case study of East-German biologist Günter Tembrock (1918–2011), who maintained his own collection of newspaper clippings, drawings, photographs, and films, offers a new perspective on the methodological development of this field. Furthermore, this article contributes to a scholarly discussion geared toward expanding the spaces of ethological research. My analysis of the image collections of

S. Gräfe
Philipps-University Marburg, Department of Media Studies
E-mail: sophia.graefe@uni-marburg.de

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the Forschungsstätte für Tierpsychologie presents the archive as a relevant site of study in the history of ethology.

**Keywords:** Günter Tembrock (1918–2011), Forschungsstätte für Tierpsychologie, ethology, animal psychology, zoological garden, red fox, image collections, card box index, photography, film, drawing, scientific archives

1. **Introduction**

In the late summer of 1951, East German biologist Günter Tembrock (1918–2011) sent a letter to the Leipzig Zoo. At long last, he was able to pay a visit to the zoological garden before the start of the academic year, when he would resume his teaching duties at the Zoologisches Institut of the Humboldt-Universität zu Berlin. This visit was not of a private nature: he was hoping to consult with the director of the renowned institution, Karl Max Schneider (1887–1955), who was also an expert in animal psychology (Tierpsychologie). Tembrock, who had devoted himself to the comparative study of mammalian behavior since 1947, had recently acquired a new laboratory animal. A male fox, said to be from Tashkent, exhibited noticeable different behaviors than the other animals in his research station. The behavioral profile of all the foxes he had examined varied considerably—and each had a different biography, some having been raised by hunters, others originating from zoos, pet shops, or private homes, but “Jupp” exhibited deviant behaviors which Tembrock found difficult to classify. For this reason, he sent two research questions ahead of his visit. First, he asked whether Schneider had experience with Russian breeds of the red fox. His second question, however, was more intriguing: “Furthermore, I would like to inquire whether you have pictures in the image archive of the...”

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1 Copy of a letter from Günter Tembrock to Karl Max Schneider, 24 August 1951, Tembrock-Forschungssammlung Berlin [henceforth: TFSB], Correspondence, Folder 1951–1952.
2 In the late 1940s, many German-speaking researchers, later titled ethologists, still chose this terminology, see also the Zeitschrift für Tierpsychologie, initiated in 1937 by the Deutsche Gesellschaft für Tierpsychologie, edited by Konrad Lorenz, Otto Koehler, and Carl Kronacher. On the history of this journal, later renamed Ethology, see Von den Berg 2008, on 153–166. In his own studies on the history of modern behavioral biology, Günter Tembrock discussed the productive relationship between comparative psychology and animal psychology of a physiological or biological nature. Both fields, according to Tembrock, are to be regarded as parallel developments leading up to ethology in the German speaking area, see Tembrock 1956, on 13; Tembrock 1985, on 299.
3 On the concept of animal biography, see Krebber and Roscher 2018; esp. Chrulew 2018.
4 The records taken at the arrival of each animal show the diversity of their origins. In addition to animal dealers and zoos, employees of the Zoologisches Institut caught wild animals during expeditions within the GDR and on the outskirts of Berlin. Individual citizens also offered wild animals to the research station, see Tier-Tagesprotokolle [Daily Protocols on Animals], 1949–1951, Universitätsarchiv der Humboldt-Universität zu Berlin [henceforth HUUA], Mat.-Nat. Fak., Zool. Inst. 02, 6632.
garden that could be used for behavioral sketches [Verhaltensskizzen] of the *Vulpes* group […] and whether I could have a look at them? Even though the Leipzig Zoo exhibited foxes at that time, Tembrock’s method of studying animals seemed to require research objects of a different type. His behavioral investigation was less about inspecting the rare specimens in the outdoor exhibit and more about exploring animal images in the zoo’s archive. What, we might ask, were the reasons for this choice?

This paper tackles the epistemic career of visual media in ethology in the mid-20th century. The case of Tembrock, who kept an image archive of newspaper clippings, drawings, photographs, and films, offers a new perspective on the methodology of this field. Above all, ethologists claimed close contact with research animals and drew scientific evidence from these human-animal communities, particularly in public relations. However, if we look beyond such demonstrations of animal connoisseurship and into the toolboxes of comparative behavioral biologists, it becomes evident that scientifically valid research results were primarily obtained by experimenting with model images. These new specimens tell a technical story about the methodological requirements in behavioral science necessary to bridge everyday observations between the laboratory and the field. Furthermore, they help answer the question of how Tembrock intended to reproduce natural behavior with only a few animals in the study rooms of the Forschungsstätte für Tierpsychologie in the

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5 Copy of a letter from Günter Tembrock to Karl Max Schneider, 24 August 1951, TFSB, Correspondence, Folder 1951–1952: “Ferner möchte ich anfragen, ob Sie in dem Bildarchiv des Gartens Aufnahmen haben, die für Verhaltensskizzen der *Vulpes*-Gruppe (nach Art der SCHENKELschen Wolfsskizzen) verwendet werden können und ob ich diese bei Ihnen einsehen könnte?”

6 Today, Schneider’s image collection is part of the Karl-Max-Schneider-Stiftung. It is accessible through the Museum der Stadt Lichtenstein/Sachsen. On Schneider, see Schulze 1987; Meier 2003.

7 Here I rely on the large corpus of studies in the history of science, which are dealing with the epistemological relevance of images. An intellectual genealogy can be drawn with the help of the following works: Crary 1990; Lynch and Woolgar 1990; Latour 1986; Rheinberger 2009. Furthermore, my work is informed by literature from the fields of art history, image philosophy, and media studies. One of most important books in the first two disciplines is by Voss 2010.

8 I draw inspiration from Tania Munz, who integrated an analysis of sketches, images, and films in her writings on Konrad Lorenz’ and Karl von Frisch’s behavioral science: Munz 2005; Munz 2016. See also Gregg Mitman’s work on film in American animal behavior research: Mitman 1993; Mitman 1999. Schulz-Figueroa 2018 investigated animal research films made by comparative psychologists, primarily focusing on behaviorism. Kunst 2010 examined films of Jakob Johann von Uexküll (1864–1944), Scholtz 2021 analyzed an educational film by Lorenz. For classical literature on the history of ethology written by protagonists from this field, see Dewsbury 1985; Wuketits 1995; and Klopfer 1999. Historian Richard W. Burkhardt is one of the few scholars, contributing work from an external perspective. The list of his publications is vast, but the following two titles provide an overview of his approach to a historiography of ethology: Burkhardt 1981; Burkhardt 2005. I would add a study by the little-known biologist and historian of science Volker Schurig, who tells the history of ethology in the style of a conceptual history. See, e.g., Schurig 1993; Schurig 2014.

9 See Kaufmann 2018.

10 On the concept of images as models, see Reichle et al. 2008. For a general account on models and modelling, see Balke et al. 2014; Ludwig et al. 2014.
center of Berlin. Making rigorous claims about the typical behavior of animals only from experiences in the lab demanded extended observation, a strict protocol in data management, and the use of multiple audio-visual recording devices. Tembrock’s simulation of a species’ behavioral program using caged specimens was enabled by a network of analog media that, before the advent of computer-aided observation, shifted the observational paradigm in behavioral research to a datafication of living behaviors that is still relevant today.

In what follows, I focus on two examples of imaging techniques in the 1950s, an important decade in the institutionalization and popularization of modern behavioral research. The historical material originates from the scientific estate of Günter Tembrock. Yet, the epistemic traces of these media appear in the published texts of the behavioral biologist as well. His ethological picture card index and schematic drawings represent different stages of a turn to visual media within the establishment of modern behavioral biology. As part of this approach, I combine perspectives from the history of science and media studies. Looking both at historical debates about the appropriate method of objective behavioral research and connected visual practices allows for a deeper understanding of the establishment of this discipline. Furthermore, this article contributes to a scholarly discussion geared toward expanding the spaces of ethological research. My analysis of the image collections of the Forschungsstätte für Tierpsychologie presents the archive as a relevant site of study in the history of ethology. First, I will provide background on the relationship of ethology to the study of living animal behavior in the history of biology. In a second step, I discuss the methodological significance of a skillful use of images in the context of the establishment of ethology in the mid-20th century. I show how the detection of ethologically significant bodily signs was related not only to the development of a specific notational system and workable vocabulary, but also an adept use of ethological photographs, films, and hand drawings. As such, these schematic representations extracted iconic moments of behavior that provided the basis for subsequent terminological definition. Finally, I unpack the conceptual consequences that result from this new perspective on the history of ethology as media history.

2. Ethology: The Study of Behavior in Living Animals

Tembrock’s interest in the inanimate elements of the zoological garden is quite remarkable considering the shared history of zoological gardens and academic

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11 In the context of this paper, I use the term “datafication” to address changes in the experimental landscape of behavioral research in the 1950s and a set of procedures that generated reservoirs of (pre-digital) data from ethological observations. This relates to further studies, e.g., in the history of data, such as Aronova et al. 2017; esp. Müller-Wille 2017.
12 See Burkhardt 1999; Burkhardt 2022, this issue.
13 On archives as sites of scientific inquiry, see Daston 2017. See also Te Heesen and Spary 2001 for related practices of collecting in the history of science.
institutions of zoology.\textsuperscript{14} Even before modern biology became a scientific
discipline, zoological gardens such as the \textit{Ménagerie} of the \textit{Muséum national
d'histoire naturelle} in Paris opened up spaces where theoretical knowledge was
tested against the observation of living organisms.\textsuperscript{15} They provided researchers
with local settings for the controlled study of natural history. In the course of
the nineteenth century, these treasure troves of both domestic and exotic
animals gradually enabled academic natural history to turn its attention to the
study of living organisms. In fact, academic impulses inspired efforts to found
the first wave of public zoos in Europe.\textsuperscript{16} Although these endeavors would
often face difficulties in establishing the reliability of zoo observations among
their peers,\textsuperscript{17} nonetheless, the broader scholarly community soon came to
appreciate these artificial natural worlds\textsuperscript{18} as a source for the study of animal
behavior.\textsuperscript{19} This development was further supported by the installation of
aquariums and animal enclosures in universities during the construction of
new buildings for the emerging academic zoology.\textsuperscript{20} The \textit{Zoologisches Institut}
of the \textit{Humboldt-Universität zu Berlin}, founded in 1887, was equipped with a
pond and animal cages in the garden, as well as aquariums and terrariums in
the basement and under the attic of the building.\textsuperscript{21} They facilitated experimen-
tation and long-term observation on the spot.

The installation of animal enclosures in universities can be seen as a
symptom of a larger transformation in academic zoology. In the last third of
the nineteenth century, Charles Darwin’s theory of evolution catalyzed the
demand for zoological research stations.\textsuperscript{22} The central question of the
evolutionary development of species through adaptation to a particular
environment required the study of living animals. Anton Dohrn (1840–1909),
a zoologist based in Jena, set out the decisive dictum for this idea: for him,
only through close observation of animal “habits of life” (Lebensgewohnheiten) and the nature of the “medium in which the animal lives” could the external factors essential to the process of a specific organism’s adaptation become evident.\textsuperscript{23} Research stations furnished with libraries, instruments, and animals, such as the Zoologische Station Neapel founded by Dohrn in 1874, allowed for increasingly more complex physiological-evolutionary observations when compared with existing collections of anatomical and embryological specimens in museum-based zoology. For Dohrn, dead museum specimens were regarded as situational fragments of a phylogenetic history that had become porous and devoid of context.\textsuperscript{24}

By the beginning of the twentieth century, the alliance between the academy and the zoo had extended to the point that experts on the habits of animals placed themselves demonstratively in the tradition of experienced animal keepers. Bird lovers and animal enthusiasts like Konrad Lorenz (1903–1989), started their own zoological gardens and interspecies housing projects near or within their research facilities.\textsuperscript{25} They proposed to observe the entire life cycle of as many specimens as possible without interruption. From the 1930s onward, the intimate study of living animals gradually became the bedrock and emblem of biological behavioral science. Working towards this expertise, the developing field of ethology distinguished itself from a parallel disciplinary stream in animal psychology, rooted in the theories and questions of human psychology and therefore considered overly anthropomorphic.\textsuperscript{26} It was also in the process of distancing itself from the experimental methods of behaviorism as well as Pavlov’s reflex theory, which were dismissed as being too far removed from the concept of natural behavior.\textsuperscript{27}

Tembrock joined this newer program. In the late 1940s, he roamed throughout Berlin with his colleagues in search of living material for a new research station. He wanted to spend time with wild animals on a daily basis, studying a wide variety of species by means of what he called “comparative animal psychology.”\textsuperscript{28} With the help of two assistants, the young researcher established an improvised behavioral lab, the Forschungsstelle für Tierpsychologie.
(Research Center for Animal Psychology), in office rooms neighboring the Museum für Naturkunde Berlin (Berlin Natural History Museum).29 It is said that out of mere coincidence—but perhaps it was their pleasant size and plentiful presence—the first red fox arrived at the biologist’s workspace as a gift from the Berlin Zoo.30 This was a unique choice of subject given that historically, biological behavioral research conducted in university laboratories favored other animal groups such as birds and fishes.31 Tembrock, however, was keen to study mammalian behavior. Foxes seemed to be wild enough to display natural behavior, untainted by domestication. On a practical level, red foxes were comparatively easy to tame when captured at an early age and were less prone than others such as wolves, lions, and tigers to violently lash out at their human captors. From then on, red foxes served as model organisms32 for Tembrock’s approach to modern behavioral biology.

A year after setting up his research station on the second floor of the Zoologisches Institut in the center of Berlin, he reported to Konrad Lorenz:

Six foxes are currently living with us. Some golden hamsters, a Siberian tree hawk, a little owl and a magpie as well as squirrels and various cichlids complete our small zoo. […] The first rule for us is always: Whoever works with animals must be in friendly contact with them all the time, and must not see them only while experimenting.33

These lines express Tembrock’s ostentatious aspiration towards the ideal of a shared habitat. They also indicate the actual incorporation of the zoo within the university. Instead of transferring his laboratory to the zoo, Tembrock designed the research facility for animal psychology according to the rules of a scientifically optimized zoological garden—without visitors or opening hours.34 While interruptions to observations at the zoo were a constant nuisance, living with the animals at the institute promised, ultimately, recognition of the researcher within the social milieu of ethology.

How does Tembrock’s affinity with pictorial representations of behavior relate to this story? Why was he interested in the Leipzig Zoo’s collection of images, of all things—a static collection of two-dimensional objects, and a

29 On the spatial layout of the Zoologisches Institut, see Tembrock 1961a, on 112.
30 In the post-war years, the zoological garden in Berlin was restricted to exhibiting mainly domestic species due to missing trade permits with foreign countries. See the copy of a letter by Katharina Heinroth (1897–1989), director of the zoo since 1945, to the Berlin administration of urban forestry, 20 February 1946, Archiv der Zoologischen Gärten Berlin (AZGB), O 0/1/37. Soon there were plenty of red foxes.
31 On classical model organisms in ethology, see Lorenz 1941, on 201.
32 On the concept of model organism, originally derived from studies of molecular genetics, see Clarke and Fujimura 1992; Creager et al. 2007; Kohler 1994; and Endersby 2007. See also Pettit 2010; Bolman 2018; Bolman 2022, this issue, for studies on model organisms and their multifaceted histories across science and society.
33 Copy of a letter by Günter Tembrock to Konrad Lorenz, 25 August 1949, TFSB, Correspondence, Folder 1948–1950: “Es ist bei uns stets das erste Gebot, wer mit den Tieren arbeitet, muss ständig mit ihnen freundschaftlich verkehren, und darf sie nicht nur beim Versuch sehen.”
34 This attempt goes back to the idea of the biological farm, see Charles Otis Whitman (1842–1910), who stated: “The most favorable combination of conditions may be utterly worthless, unless the farm can be made secure in its isolation from the public.” Whitman 1902, on 233.
seemingly bygone relic of biological research that had emancipated itself from armchair zoology? If we consider the practice of Tembrock’s behavioral research, however, images become essential, helping him solve some of the major methodological problems in comparative behavioral studies. When, in 1951, Tembrock asked Schneider for help getting access to images, rather than the animals themselves, he was attempting to collect another behavioral specimen that could be logged into his existing image repository. With the help of images, he generated schematic drawings of characteristic postures and constellations of animal bodies, which allowed him to trace the characteristics of individual forms of behavior across individual cases and deviations. His visit to the Leipzig archive therefore represented a part of his daily research routine as much as feeding the animals.\textsuperscript{35} Feeling the constant tug of his own observational biases and struggling with the individuality of single animals, he and other contemporary behavioral biologists developed media archives of all kinds to accompany their centers of observation. These specialized collections served as tools for a calculated approximation of species-specific, typical behavior. For this reason, this paper offers a rereading of the history of ethology through the lens of its visual media. I will first describe the everyday research practice of Tembrock, and then discuss further examples of image production in the history of ethology.

3. Wildlife on DIN A4: Behavioral Research at the Forschungsstätte für Tierpsychologie

1957 was a successful year for Tembrock. The East German biologist was finally delivering his findings to the scientific world. His 250-page essay, published in Der Zoologische Garten, the oldest magazine of Central European zoos, presented his approach to modern behavioral biology.\textsuperscript{36} Over the course of ten years, he had observed tame animals in his laboratory in the center of Berlin, named Forschungsstelle für Tierpsychologie. The research room, which measured five square meters, contained a desk, cages, a chair, an oven, and a specially adapted door with an observational window in it, so that the team could gaze at the animals from the outside of the enclosure.\textsuperscript{37} The entrance door was built from a recycled telephone booth, which concealed the observers in an upright position so that they could look into the animals’ room undetected. Next to that facility, Tembrock also kept research organisms in a garden, a basement and one attic, all of which are today part of the Museum für Naturkunde Berlin.

Tembrock needed each of those 250 pages to catalogue seemingly all possibly behaviors of the red fox. Indeed, this exhaustiveness was the key to the paper’s success. Commentators on the essay were enthusiastic about the extensive information gathered about the rearing of these wild animals, their

\textsuperscript{35} On the practice of feeding in the history of zoology, see Reiß 2012.
\textsuperscript{36} Tembrock 1957. On the history of the Der Zoologische Garten journal, see Reiß 2020, on 91–96.
\textsuperscript{37} Tembrock 1957, on 294.
mating and fighting behavior, social life, and communication. In fact, they claimed that Tembrock’s findings corresponded with their analogous observations in the wild. These unforeseen results were made possible by a unique use and adaptation of media technologies. Letters in the archive from Tembrock and his team show that the systematic use of photography and film was planned from the early stages of developing the concept of the research station. In a letter to the German Academy of Sciences at Berlin in 1947, Tembrock revealed the rationale behind his turn to technical media in behavioral research. Surprisingly, it was not the upkeep costs for living animals, their cages, or nutrition that were listed first in the lab budget. Tembrock requested money to hire research assistants who would help establish a rigorous protocol of observing and recording behavior, activities Tembrock had failed to implement in his earlier attempt at behavioral research within the Berlin Zoo. His new lab, which began operation in 1948, was free from distraction by visitors to the zoo, easier to control.

However, exercising control was not the only struggle Tembrock hoped to overcome by setting up a rigid network of recording. His letter to the Academy also shows how behavioral researchers were pushing to distance themselves from the protagonists of animal psychology. Since the 1850s, animals had served as anthropological mirror objects in human and animal psychology. This was reinforced, at the time, by Darwin’s groundbreaking work on the evolution of man. However, for a long time, both disciplines were built on anecdotal and anthropomorphic modes of examination. By the 1940s, Tembrock and his ethology colleagues feared their specialty would never be able to achieve a notable scientific reputation.

Turning towards automation was one idea put forward to overcome the perceived trap of subjectivity. Tembrock’s protocols on fox behavior span from 1948 to around 1967, nearly 20 years of recording (see Figure 1). In his

38 See Müller-Using 1958.
39 See Günter Tembrock, “Denkschrift zur Begründung eines Institutes für Tierpsychologie,” TFSB, Correspondence, Folder 1948–1950.
40 Ibid., on 4.
41 On the importance of control in the history of behavioral psychology, see Mills 1998.
42 The biggest damage to the reputation of the emerging field of ethology had been caused by studies on animal intelligence in animal psychology, which, for example, examined the ability of animals to count or to calculate. On the famous incident of the “Kluger Hans,” see Zandt 2013. Moreover, the inductive method of comparative behavioral biology fostered doubts about the scientific rigor of ethological studies. See Lorenz 1937a, on 28: “How many authors are there who try to study their animals under conditions as natural as possible, corresponding to the habitat of the species? The fact that analysis from the whole to the part, especially in the field of behavioral sciences, has received so little attention so far is probably mainly due to psychological reasons: It does not look ‘scientific.’ Its beginning requires neither complicated apparatus, nor laboratories, and it does not soon yield a ‘result’ that can be written as a summary of a scientific paper.” Translation by the author.
43 See Tembrock 1961b, on 21–24.
44 Fuchspräokolle [Protocols on Fox Behavior], Forschungsstätte für Tierpsychologie, 1948–1967, TFSB, online: https://soundandscience.de/node/2454 (accessed 6 April 2022). See also Gräfe and Hui 2020.
celebrated article on the “Ethologie des Rotfuchses” (1957), Tembrock explained how, in order to truly secure the validity of his observations, a daily and consistent routine of protocols was mandatory. He states that he himself sat down to observe the foxes at a set time each day—between 5 and 7:30 p.m.—while feeding the animals, except on weekends and holidays. This resulted, following his calculations, to between 70 to 120 entries per week in his protocol books over the course of several years.45 This quantification of attention as an epistemic virtue can be found in his letters to editors of journals as well. For example, in February 1957, he wrote to Otto Koehler (1889–1974), editor of the famous journal Zeitschrift für Tierpsychologie (later Ethology), to advertise for an upcoming paper on the play habits of red foxes, claiming that he had “1000 notes about this on hand.”46

The researcher’s protocols represent the nucleus of his rigorous registry of behavioral data.47 They also allow the user to navigate through the records of eating, playing, fighting, sleeping and copulating of the animals, as well as the biologist’s media archive. The behaviors of the animals as well as the archival procedures of the scientists were recorded on the same pages of the protocol. Individual film, image and sound recordings were marked with a date, time

45 Tembrock 1957, on 295.
46 Copy of a letter by Günter Tembrock to Otto Koehler, 26 February 1957, TFSB, Correspondence, Folder 1957. On the history of the Zeitschrift für Tierpsychologie journal, see footnote 2.
47 The following thoughts refer to existing studies historiographical research of notebooks in the history of science, see Lenoir 1998; Holmes et al. 2003; Te Heesen 2005; Hoffmann 2008. On the epistemology of protocols, see Hoffmann 2009; Niehaus and Schmidt-Hannisa 2005.
and number, such that they can still be located in the corresponding collections today. The continuous data collection implied a daily practice that tied the researchers to their research animals. Likewise, it shaped the architectural features of the research station. Viewing ports in the fox room, in addition to a later outdoor enclosure for the animals positioned under the biologist’s window, configured an optical apparatus encircling animal behavior. After 1951, written protocols and photographs were accompanied by film and sound recordings, which connected sound to images and bodies to vocalizations.

Remarkably, Tembrock also worked on further automating the recording of behavior. A microphone pedestal was set up in the outdoor enclosure of the Forschungstätte für Tierpsychologie, which transmitted sounds to the observer’s office via an aerial cable. In the mid-1950s, he also had a so-called Aktograph installed, a wooden board that was assembled on the ground and was activated when stepped over by the foxes. The vibration of their gait was recorded on the paper roll of a kymograph, thus revealing the diurnal rhythms of their activity. If it was not possible for Tembrock to live with the foxes all the time, he still insisted on the continuity of the protocol. In this case, cohabitation took shape as the constant presence of recording devices.

4. Ethology’s Imageries

How do images relate to this documentary desire? There is no easy answer to this question. The skepticism about the integrity of even technically supported depictions, namely analog photography, is as old as the history of photography itself. Moreover, as Lorraine Daston and Peter Galison have shown in their well-known work on the history of scientific objectivity, pictorial processes were not guarantees of a watertight record—more importantly, they were not necessarily objective. The evidential and epistemic value of any given image relies on the very concept of observation: a particular frame of image-based objectivity, as well as historically unstable notions of the training required to

48 On technologies of synchronization, see Kassung und Macho 2013.
49 This outdoor enclosure is described in Tembrock 1959, on 351.
50 Ibid, on 352. Tembrock’s work on animal sounds was central to establishing modern bioacoustics. He also initiated the Tierstimmenarchiv (Animal Sound Archive) at Museum für Naturkunde Berlin, see Frommolt 1993; Wessel 2011. Further research needs to be done to clarify the connections between his image collections and bioacoustical studies.
51 Tembrock 1956, on 107–108. On the use of kymographs in the history of science, see Chadarevian 1993; Ernst 2012.
52 The Aktograph apparatus is described in Tembrock 1958, on 298–300. Tembrock also directed an educational film on activity periods in animals: Günter Tembrock, Aktivitätsperiodik bei Tieren (16 mm, b/w, sound, 27 min.), T-HF 423, Deutsches Institut für Film, Bild und Ton in Lehre und Forschung, produced by Deutsches Zentralinstitut für Lehrmittel (DZL), 1962, HUUA, Hochschulfilm- und Bildstelle (HFB), film collection.
53 On animal housing and human-animal cohabitation, see Bjorkdahl and Druglirto 2016; Wischermann et al. 2019.
54 See Daston and Galison 1992; Daston and Galison 2007.
handle images as evidence. The visual culture of ethology is characterized by diverse uses of images that, at first glance, seem merely to verify scientific observations. A closer look at the research methods of leading figures in the field and a re-reading of their publications in terms of hypotheses about the epistemic role of images clarifies the ways in which images, in addition to their general role as records and evidence, could also serve as actual sites for ethological research. In what follows, I give selected examples from protagonists associated with the classical school of ethology to illustrate the main uses of images and situate them in relation to Tembrock’s image archive. My aim is to show how some of the key challenges in developing an objective method for studying the biological basis of behavior in ethology converged with a range of imaging techniques.

The story of the “first ethologist,” or the sites and causes for the establishment of ethology, can be told in many different ways. Just as the field of ethology was constantly changing and participants were involved in a continuous process of negotiation about valid methods and convincing concepts, accounts of the birth of ethology diverge. For the purpose of this paper, I will focus on those references, which, at the time of the establishment of the Forschungsstätte für Tierpsychologie, constituted key references in the emerging field. For the Berlin-based biologist Tembrock, these were, in addition to Lorenz, his Dutch colleague Nikolaas Tinbergen (1907–1988), whose monograph *The Study of Instinct* (1951) had been translated into German by Otto Koehler only a year after its publication, as well as Oskar Heinroth (1871–1945), who was director of the Berlin aquarium and an ornithologist with a strong scientific network. Lorenz had established a scientific correspondence with Heinroth early on. Heinroth, an animal gardener and expert on ducks, was the ideal conversation partner for the Austrian researcher, who was striving to establish a biological study of behavior following the model of comparative morphology. Between 1924 and 1934, Heinroth, together with his partner and zoologist, Magdalena Heinroth (1883–1932), had published a series of four photographic compendia *Die Vögel Mitteleuropas* (The Birds of Central Europe). They showed over 3,000 photos of hundreds of bird species portrayed in various stages of development at the couple’s private home as well as in a photo studio at the Berlin Zoo. To Lorenz, Heinroth’s serial photographs, coupled with the principle of an intimate long-term observation of as many species as possible for the ethological study of kinship, represented the methodological nucleus of

55 See Tinbergen 1942.
56 Schurig 1993.
57 See also Burkhardt 2022.
58 See Tinbergen 1952. Tembrock himself published several texts on the history of animal psychology and ethology, see, e.g., Tembrock 1985; Tembrock 2002; Tembrock 2013.
59 See Schulze-Hagen and Birkhead 2015; Schulze-Hagen and Kaiser 2020.
comparative behavioral research.60 Finally, a remark published by Heinroth as early as in 1910, was later seen as the starting point of modern behavioral research: “The study of the ethology of higher animals—still, unfortunately, a very much unexplored field—is increasingly going to lead us to the conclusion that our behavior towards family and friends, our love life and the like are purely innate, much more primitive processes than we commonly believe.” Photographs were to provide him with evidence for this claim.61 Even if the studio photographs of Die Vögel Mitteleuropas only depicted ontogenetic stages of development and individual forms of display behavior, these Natur-Urkunden (nature records)62 contributed to a general enthusiasm for image collections. Tembrock, who had access to both the collections of the Zoologisches Museum and the Berlin Zoo, and who frequently visited the atelier of the Heinroths through meetings of the Deutsche Ornithologische Gesellschaft as well as the Gesellschaft Naturforschender Freunde, certainly knew the Heinroths’ photo collection.63

Lorenz’s letters to Heinroth published in 198864 as well as his decisive early works such as “Vergleichende Bewegungsstudien an Anatiden” (1941) feature schematic hand drawings that graphically indicate sequences of movement or the direction of an individual motion.65 They were first and foremost tools for communication. Although the aesthetics of the Heinroths’ atelier photographs clearly differ from this approach, they were driven by a similar motif: the search for phylogenetically relevant behaviors, a call both answered with the help of images. Secondly, Lorenz’s drawings also clearly show his analytical interest in behavior as a procedural form. In his private research station in Altenberg near Vienna, he had undertaken ethological analyses with the aid of photographs and films, using photographs to detect the individual phases of an instinctive movement on the one hand, and slowing down the details of fast

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60 See Lorenz 1941, on 203. See also Tinbergen on the methodological demands, especially imperative in “objectivistic comparative ethology:” “First, there is a need for ever increasing d e t a i l e d n e s s. Secondly, consideration of the w h o l e behavior pattern of a species is necessary. Thirdly, c o m p a r i s o n of behavior patterns of many different species is needed.” Tinbergen 1942, on 43.
61 “Das Studium der Ethologie der höheren Tiere—leider ein noch sehr unbeackertes Feld—wird uns immer mehr zu der Erkenntnis bringen, dass es sich bei unserem Benehmen gegen Familie und Fremde, beim Liebesleben und ähnlichem um rein angeborene, viel primitivere Vorgänge handelt, als wir gemeinhin glauben.” Heinroth 1911, on 702. On Lorenz’s appraisal of Heinroth as the “father” of ethology, see, e. g., Koenig 1988, on 42; Lorenz 1935. See also Lorenz 1958; Lorenz 1971.
62 O. Heinroth 1911, on 590–591.
63 M. Heinroth 1911, on 703. Magdalena Heinroth refers to the popular photo book series by Georg Ernst Friedrich Schulz (1875–1959): Schulz 1908. On the history of the term “Natur-Urkunden,” see Nessler 2018, esp. 24–29. See also Gall 2021. On Schulz, a pioneer of nature photography and educational film, see Zillmann 2019.
64 Today, remnants of the Heinroth image collection are part of the Archiv der Zoologischen Gärten Berlin.
65 See Koenig 1988.
66 See, e. g., Lorenz 1941, on 219; Koenig 1988, on 100.
movements or complex interactions between animals with the aid of the film camera on the other. They allowed him to “see in slow motion”:

In most cases, it is only after watching a process countless times that one realizes that it is always the same, sharply defined process. […] By knowing the movement in each section, by taking a picture of each section, one finally gets the possibility to string these pictures together and to interpolate them, to get ‘slow-motion eyes,’ so to speak. Here, the camera, of course, is a tremendous help, both the ordinary camera and the film camera.  

Lorenz made efforts for closely observing and recording even the smallest details in animal movements, which could reveal the characteristics of individual behaviors by continuous repetition. According to Lorenz, failure to do so runs the risk of focusing on behavioral details that are merely coincidental or pathological, or even worse, irrelevant for the identification of evolutionary lineages.

But, even the most experienced observer made mistakes. Since it was difficult for a single researcher to eliminate the danger of misperception, publishing the respective documents and combining as many observational data as possible in shared archives became a requirement in ethological research. Furthermore, it allowed colleagues to gain access to research data from their peers. Nikolaas Tinbergen, who would join Lorenz for research on bird behavior on his visit to Altenberg in 1937, was equally keen on promoting visual documents of behavior. In 1948, he advocated systematic publication of images alongside descriptions of new findings on behavioral phenomena:

[It] would be advisable to publish such facts more often than has been done in the past. A short, accurate description, with a sketch or photograph, not taking, in all, more than one

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67 Lorenz’s use of images thus corresponded both to the established use of hand drawings for the analysis of individual forms of expression, next to experiments with continuous image capture techniques made possible by Étienne-Jules Marey’s chronophotography and later by the technique of continuous motion recording invented by Eadweard Muybridge (1830–1904), see Marey 1891; Muybridge 1872–1885. The German Reichsstelle für den Unterrichtsfilm (RfdU, later RWU) supported Lorenz research activities with film equipment, see Burkhardt 2005, on 233. The young Alfred Seitz (1905–1982) assisted with filming in Altenberg, see Burkhardt 2005, on 245. Footage of gray geese, shot between 1935 and 1937, was published in 1950 as an educational film and is considered one of the most popular scientific films of the Institut für den Wissenschaftlichen Film: Konrad Lorenz, *Ethologie der Graugans* (16 mm, b/w, silent, 12:30 min.), C-560, Institut für den Wissenschaftlichen Film Göttingen, 1937, Filmsammlung des ehemaligen Instituts für den Wissenschaftlichen Film (IWF), Technische Informationsbibliothek Hannover (TiB). See Scholz 2021, on 332. The original film footage is accessible through the Österreichisches Filmmuseum, depot Konrad Lorenz.

68 “Meist fällt einem ja erst, nachdem man einen Vorgang unzählige Male zu sehen bekommen hat, überhaupt auf, daß es sich da immer um denselben, scharf umrissten Vorgang handelt. […] Dadurch, daß man dann die Bewegung in jedem Abschnitte kennt, sich von jedem Abschnitt ein Bild macht, bekommt man schließlich die Möglichkeit, diese Bilder aneinanderzureihen und zu interpolieren, bekommt sozusagen ‘Zeitlupenaugen.’ Eine ganz ungeheure Hilfe leistet dabei natürlich die Kamera, und zwar sowohl die gewöhnliche als die Kinokamera.” Lorenz 1935, on 110. See also Canales 2009, esp. 117–153.

69 See Lorenz 1941, on 198–200.

70 See Burkhardt 2005, on 205–213.
or two pages of an ornithological journal, would be sufficient and would materially help to extend our knowledge.\textsuperscript{71}

At about the same time the demand for establishing type specimens in the context of species identification and nomenclature was growing in the field of biology in general. Until the 19th century “discovery”\textsuperscript{72} of new species was mainly based on the expert principle, i.e. individual researchers vouched with their reputation for the quality and validity of the new name they assigned.\textsuperscript{73} At the beginning of the 20th century there was an increased need to link the system of assigning species names to specific animal specimens to counteract an excess of new species names, some of which were accidentally assigned to multiple species. In other cases, individual species had been given several names over the years without their authors being aware of this mistake because the animal material used in the initial description of the species was not documented.\textsuperscript{74}

In the context of behavioral studies, stuffed animals had been rendered useless. Other reference objects were needed for the scientific exchange about novel observations. Having initially relied only on his own expertise (ostensibly to counteract the lack of comparability of behavioral observations by several observers),\textsuperscript{75} Lorenz outlined this need for an image-driven nomenclature of behavior in 1937:

\begin{quote}
[A] clear description, according to which a behavior can be recognized with real certainty, is the greatest difficulty. First of all, there is the demand for a useful and uniform nomenclature. [...] Even with the establishment of a useful nomenclature, understanding what has been observed, especially comparing observations, is very difficult. [...] Of course, there is only one way out of these difficulties, and that is the photograph, possibly the film.\textsuperscript{76}
\end{quote}

Konrad Lorenz built up his own image and film collections and became advocate of the \textit{Encyclopaedia Cinematographica} project, founded by the \textit{Institut
für den Wissenschaftlichen Film (IWF) in 1952. The scientific film archive provided comparative footage of the behavior of species that were not available to the individual researcher as living specimens. Taking the classical written encyclopedia as its model, standardized filmstrips made available to researchers internationally were meant to store units of multispecies behavior as so-called Bewegungsdauerpärate (permanent specimen of movement). By the mid-20th century, the precise depiction and analysis of behavioral forms with the help of photography and film was considered an essential ethological skill. As a result, image capture and production went hand in hand with the basic methodological principles of the discipline: the ethological categorization of behavior, which focused on Gestalt as an expression of behavior, and the mode of visual comparison. Images enhanced the observers’ visual perception, backed up their memory during detailed and long-time comparative studies, verified their results as well as illustrated their research reports. The most important aspect of the visual culture of ethology, however, is that images of this discipline certainly also operated as specimens of behavior, i.e., as the site of ethological research itself.

77 Lorenz’s films had both an experimental and a rhetorical use, see Burkhart 2005, esp. 401–402; Scholz 2021. On Lorenz’s film collection, see Schleidt and Oeser 2011a; Schleidt and Oeser 2011b. On the Encyclopaedia Cinematographica, an international scientific film collection, initiated in 1952 by the Institute for the Scientific Film (IWF) in Göttingen, see, e.g., Wolf 1952; Wolf 1953; Wolf 1967. See also Gräfe 2011; Gaycken 2021. On the history of the IWF, see Große 2012. On the use of film for Tinbergen’s research activities, see Mitman 1999, esp. 70–84. Irenäus Eibl-Eibesfeldt also took a great interest in the Encyclopaedia Cinematographica and was particularly involved in its ethnographic section, see Hediger 2017. On Eibl-Eibesfeldt, see also Odenwald 2022, this issue.

78 See also Rudwick 2000 for an analysis of the “paper museum” of Georges Cuvier (1769–1832), who collected drawings of fossil bones, which functioned as paper “proxies” for specimens.

79 On the history of scientific dictionaries, see Yeo 2001.

80 Wolf 1961, on 22.

81 On film production and analysis as part of the ethological method, see Tembrock 1961b, on 23. Film screenings became a regular part of conferences like the meetings of the Deutsche Ornithologische Gesellschaft, the Deutsche Gesellschaft für Tierpsychologie, as well as the International Ethological Conferences, see Burkhart 2005, on 246 and 376. Individual scientists, like Tembrock, took part in activities of the International Scientific Film Association (ISFA), initiated by Jean Painlevé, see Große 2012, on 51–53. Furthermore, the German Institute for the Scientific Film offered filmmaking workshops to scientists in Göttingen. The Defa-Studio für den populärwissenschaftlichen Film, as well as the Deutsches Zentralinstitut für Lehrmittel (DZL) supported scientific filmmaking in East Germany, see Knopfe 1996.

82 Examining “behavior” required, above all, the analysis of a physical whole rather than an (anatomized and abstracted) set of parts. On Gestalt perception, see Lorenz 1959. See also Wuketits 1995, on 67–73; Gräfe 2011, on 24–28. On visual comparison, see Wuketits 1995, on 57–67. See also Bader et al. 2010.

83 See Schultz-Figueroa 2018, who coined the term “celluloid specimen.” For studies on the pictorial qualities of specimen, see Rheinberger 2003; Grave 2009; Helbig 2017.
5. Browsing through Behavior

Tembrock’s image collections bear witness to this image-based research. Next to newspaper clippings, drawings, image slides and films, three wooden boxes with a large number of small-format black-and-white photos have been preserved from his collection (see Figure 2). The scope of these three boxes totals about 45,000 items, divided approximately into two-thirds photographs and one-third paper index cards, which exclusively deal with the behavior of a single species—the red fox. Its origins date back to the early days of the Forschungsstätte für Tierpsychologie in 1948. Handwritten annotations on the reverse sides of the photos indicate that pictures were added on a regular basis up until 1961. However, the use of the card index presumably continued afterwards. According to a former research assistant of the biologist, the boxes were installed in the library of the Forschungsstätte, and were freely accessible to all members of the research team. Next to Tembrock, the already mentioned assistants of the laboratory maintained the image collection. Imme-Dagmar Ohm-Kettner, Dietrich Ohm and others labeled the pictures on the reverse side with the name of the experimental animal, usually followed by date, time and category of behavior. The image card index provided the team with a

Figure 2. Image card index on fox behavior, detail 1, Forschungsstätte für Tierpsychologie, 1950s, © Carola Radke MfN.

84 Ethologische Bildkartei (Ethological Image Card Index), 1948–1961, Forschungsstätte für Tierpsychologie, TFSB, L0001–0003.
85 Gerda Bersch via Sylvia Wendland-Tembrock, private communication with the author, 4 January 2021.
visual encyclopedia and modular repository for ethological studies. It is the only known example of such a comprehensive pictorial registry. No similar image collection was identified in the archives of other eminent ethologists to date.⁸⁶

At least two opposing logics of categorization can be identified: The majority of the card file consists of photographs sorted either by individual experimental animal or by documenting prominent scenes in the behavioral laboratory. In addition to sections on specific lab animals, such as “Fiffi,” “Putzi,” “Jupp” and others, there are photographs taken in the context of specific events of sexual reproduction, birth, fighting, and play behavior of individual animals, and so on. Similarly, photos of individual behavioral experiments were also assigned their own separate sections in the card file. The smaller part of the collection consists of a paper card index (see Figure 3). Here, the arrangement follows an alternative principle. This second index clusters specific categories of behavior and works almost as a counter-index to the organization based on individual animals. For example, index cards on “standing,” “sitting,” “lying,” follow the “resting behaviors” tab. Each of these entries carries a brief description of the behavior in question on the reverse side of the card. In addition, they are accompanied by references to the photo collection. This second card file enabled a keyword search in the image archive. Occasionally, hand drawings of the specific form of behavior were filed in the appropriate section of the wooden boxes next to the paper cards.

These filing practices can be considered part of the collectively created ethogram.⁸⁷ The photo collection as well as the corresponding counter-index of discrete categories provided an analog database of behavior. Its configuration testifies to the ethologist’s conviction that photographic images can be used to accumulate raw data of behavioral facts that can be permanently stored—and

⁸⁶ Although Lorenz has taken photographs regularly and commissioned an assistant to maintain a film and image archive—see Schleidt and Oeser 2011b, on 47—, there are no significant surviving collections of the photographs he took in the course of his behavioral research. His scientific estate contains a small collection of photographs, which mostly consist of portraits of researchers at gatherings, conferences, and occasionally during experiments. See the image collection of the Konrad-Lorenz-Archiv Altenberg, where you can also find Lorenz’s photo camera. In contrast, there is record of a comparatively large collection of pictures by Nikolaas Tinbergen, which is stored separately from his Oxford papers in the picture collection of the Dutch Nationaal Archief in The Hague. See the Tinbergen Photo Collection at the Nationaal Archief. Akin to Tembrock’s collection, these images relate to specific research activities and can be assigned to individual manuscripts and research questions. However, in Tinbergen’s case there was no consistent image archive created by the researcher, to serve as a reference system for his ethological behavioral analysis. On scientific image collections, see Wilder 2011.

⁸⁷ A first description of an ethogram (“an exhaustive description of [the] habits”) was given by the Dutch ethologist Gerrit François Makkink (1907–2006): “In the beginning I watched some time without making notes, to acquire some orientation about the motions and sounds. After being somewhat at home with the actions of the birds, I tried to describe all the stereotyped components as fully as possible and gave every component a descriptive name. Then I continued observation and was now able to make notes by means of this terminology.” Makkink 1936, on 60 and 2. See Rheinberger 2006, on 359–361, on collective forms of note keeping in science, as well as Erika Milam 2022, this issue, on data management in selected projects of long-term behavioral studies.
then analyzed and compared in various combinations. In this sense, the ethological card index not only served as the pictorial memory of Tembrock’s research station, I would argue that its layout also practically reflects one of the basic principles of ethological behavioral studies. It divided the continuum of life into separate units of behavioral forms. Annotations on the reverse side of the photographs—names, dates, and numbers—determined their fixed position in the card index system following the model of a bibliographic card index. As a result of this procedure, ephemeral moments in behavior were given names and definitions. Like a type register, they provide for a standardization of shapes of behavior in the sheer impenetrable complexity of earthly movement. Seen in this light, Tembrock’s ethological picture image card index can be regarded as a materialization of the basic operation of ethology: the search for biologically determined forms of behavior—that can hence be found in nature in typical form. However, the blurred aesthetics of many images in the archive point to the problem of the transience of the phenomena studied by the morphology of behavior. Image-based ethology needed further image operations that sharpened the contours of individual forms of behavior.

6. Tracing Behavior

When browsing through the image collection, a particular category of images catches the eye, first appearing here and there among the photographs, and
eventually taking up an entire section of the paper section of the card index. Handmade outline drawings of the Tembrock foxes can be found on thin cardboard or tracing paper (see Figure 4). They show the display behavior of a single fox or the interaction between two animals. Compared to photographs they are images of a different type: Any trace of the place and time of the photographic image was erased in the line drawings. The untrained eye would therefore not be able to determine the identity of individual animals. These were the types of drawings based on photographs, which led Tembrock to the archives of the Leipzig Zoo. As soon as he had established his own image collection, he also began to sketch behavior using tracing paper and the abstraction it allowed. The results were hand-drawn diagrammatic representa-

Figure 4. Outline drawing of a red fox on tracing paper, Forschungsstätte für Tierpsychology, undated. © Tembrock-Forschungsammlung Berlin (TFSB).

88 On the varied history of the relationship between knowledge production and illustrations, see Amelung 2019. The close connection between drawings and scientific research in evolutionary biology was described by Voss 2010. Art historian Barbara Wittmann discussed the importance of illustrations for zoological taxonomy, see Wittmann 2013.
tions, which corresponded to another aspect in the essential methodology of ethological vision. Behavioral biologists assumed that patterns in animal movements could be identified by comparing as many views as possible. The occurrence of these quasi-morphological visual patterns gave them reason to speculate about an evolutionary predisposition to singular movements and relations that would follow the same course (Ablaufsform) or have the same appearance (Ausdruck). The success of this comparative operation was closely connected to the accurate detection of the decisive moments in which animal bodies behaved not by chance but out of biological necessity.

The schematic representations did not only distill concepts of behavior. Abstracting away the messy reality that made up the workaday lives of individual ethologists and their necessarily contextual subjects, they pulled together the observations of different researchers. Amusingly, Tembrock seemed to gladly ignore technical differences between respective research contexts. In an article on the “Imponiergehalten beim Rotfuchs im Vergleich zu anderen Säugetieren,” published in 1952, he brought together his own drawings of the expressive behavior of foxes with drawings by colleagues, amongst which Alfred Brehm (1829–1884), the famous icon of old-school animal research, who conducted his research in a less objective than anecdotal manner. With this, opposing sides of the discipline and methodological spectrum were forcibly united in the pictorial space of the biologist’s text. In his 1954 study on the expressive behavior of foxes and wolves, Tembrock referred again to the drawings of a colleague for comparison. Rudolf Schenkel (1914–2003) had observed two wolf packs at the zoo in Basel since 1934. While emphasizing the infinite variance of animal behavior, he nevertheless presented an extensive catalog of sketches of discrete behavioral forms. The preface to his study hinted at the motivation behind this decision: behavioral phenomena studied by the observer involve affects and a relational presence of animals and observers. For the purpose of scientific use, observational data has to be put at a distance. Moreover, the abundance of detail and complexity of the subject’s relations challenges the ethologist’s scholarly report. In order for the ethological descriptions to be comprehensible to colleagues, they needed to use the clearest possible language and unambiguous terminology. The subsequent reports on the behavioral repertoire of Schenkel’s wolf pack in captivity thus featured a catalog of sketches, which, according to him, did not reflect the diversity of behavior. Moreover, they lent conciseness to the biologist’s linguistic descriptions. Tembrock would later copy Schenkel’s wolf

89 On the epistemic value of images as diagrams, see, e.g., Bogen and Thürlemann 2003; Krämer 2009.
90 See also Latour 1986; Rheinberger 2009.
91 See Tembrock 1952, on 287. On Brehm and the history of scientific illustration, see Wilke 2018.
92 Tembrock 1954.
93 Schenkel 1947.
94 On human-animal entanglements in behavioral research, see Desprez 2013.
95 Schenkel 1947, on 82.
sketches into his own publication in order to conduct comparative behavioral research based on image records. In this way, the ethologists’ drawings served as tools in the search for terminological consensus. They were a product of the social negotiation of a common language for behavior.

It is worth noting that the starting point for ethological drawings was necessarily not the direct observation of the living animal. Tembrock and others often sketched from photographs and films. Some of the outline drawings were produced on tracing paper, that is, they were manually copied from photographs on transparent material. Individual films made at the Forschungsstätte für Tierpsychologie were also used for this purpose. In 1957, Tembrock recorded a short film of a fight between two foxes in the laboratory’s outdoor enclosure. For a structural analysis of the fighting behavior, he subsequently projected the filmstrip onto a drawing sheet using a ZEISS Dokumator reading device. He drew every sixth image and evaluated a total of 480 individual images for the statistical analysis of regular movement sequences in the course of a fight (see Figure 5). Patterns in the course of instinct-driven fighting behavior thus resulted from the skilled manipulation of images.

These practices bear witness to a fundamental shift in behavioral research towards image-based methodologies that have shaped the discipline since the 1950s. Certainly, the starting point of the research practice of ethologists was always the direct encounter with the animal. However, both research archives as well as published texts make apparent that a crucial detection of biological determinants of behavior relied heavily on the collection, management, and analysis of images.

7. Conclusion

The findings of this paper lead to a new historical perspective on the methods and subjects of ethology. Images drawn, photographed or filmed for behavioral studies, reveal how since the mid-20th century, the observational science of ethology adapted apparatuses for capture better associated with the experimental sciences, representing a shift in the discipline. Considering the research practices of Günter Tembrock, Konrad Lorenz and others, we can see how images were mobilized as surrogates for behavioral phenomena. These images

96 Tembrock 1954, on 154 and 156.
97 See Curtis 2011 for a similar imaging technique in infant behavior studies by Arnold Gsell (1880–1961): “The photographic image of the motion picture camera was apparently too tightly bound to the individual instance. Tracing transformed that individual moment, tied to the flow of time, into what Michael Lynch, after Husserl, calls an ‘eidetic image,’ one stripped of the temporal and concrete and thrust into the transempirical realm of pure essences.” Curtis 2011, on 432.
98 Günter Tembrock, Kampfverhalten des Rotfuchses (16 mm, 10 min), unpublished, 1957, Animal Sound Archive, Museum für Naturkunde Berlin.
99 See Wendel 1963. On devices for automatic film analysis, designed by the IWF, see Rieck 1968, on 106–113; Gräfe 2018.
100 Tembrock 1962, on 263, images on 265–266.
were themselves treated as visual evidence, becoming the object of analysis. Such systematic analysis enabled ethologists to emphasize the synthetic nature of behavioral phenomena. Knowledge about behavior was accumulated in a collage of long observation series, eventually obscuring both the individual animal and the context of the behavior.

The case of Günter Tembrock, exemplifies this shift toward data abstraction, as he accumulated collages of different animals in the constricted space of

Figure 5. Series of drawings after film shots of fighting behavior in red foxes, Forschungsstätte für Tierpsychologie, circa 1961, © Tembrock-Forschungsammlung Berlin (TFSB).
the Forschungsstätte für Tierpsychologie, consistently over more than two decades. The establishment of an ethological card filing system freed him from the continuous presence of animals, hardly sustainable in central Berlin with the limited means of his research station. The cards bridged different places and times and allowed him a cumulative mapping of behavior. Furthermore, Tembrock’s practice shows the beginnings of datafication of behavioral research in the 1950s using analog means, which would move to more data-driven research in the 1960s. Analog databases like Tembrock’s image collection prepared the ground for incipient mathematization of research on behavioral phenomena. By transforming continuous movements into discrete units they became the building blocks of early bio-cybernetics. This prompted new definitions of ethological expertise that no longer relied on close familiarity with animals, but rather integrated skillful handling of behavioral data.

This development also influenced the level of research objects. Behaviors archived in image collections, abstracted in drawings and later converted into graphs and statistics altered the ontology of ethology’s model organisms. They appear as mediated data models, always collated into synthetic behaviors in the coming age of bio-cybernetics. Even though the ethology of the 1950s had no access to contemporary computational imaging techniques such as the ones used by researcher Sophia Kimmig, who analyzed the behavior of Berlin foxes using GPS-data and statistical simulations of behavior,101 the research objects of ethology were already collective “data animals.”102

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101 See Kimmig et al. 2019; Rast et al. 2020.

102 See also Bolinski and Rieger 2019; Bolinski and Rieger 2021.
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