

Running Header: MATHILDE HERTZ

Rediscovering a Missing Link:

The Sensory Physiologist and Comparative Psychologist Mathilde Hertz (1891-1975)

Regina A. Kressley-Mba

Johann Wolfgang Goethe-University Frankfurt am Main

Siegfried Jaeger

Free University of Berlin

Corresponding Author:

Dr. Regina Kressley-Mba

Johann Wolfgang Goethe - University

Frankfurt am Main

Department of Developmental Psychology

Georg-Voigt-Str. 8

D - 60054 Frankfurt am Main / Germany

Telephone: +49 (69) 798-28260

Fax: +49 (69) 798-28595

E-Mail: kressley-mba@psych.uni-frankfurt.de

Abstract

Although her work was greatly respected by scholars from both psychology and biology such as Wolfgang Köhler, Max Wertheimer, and Karl von Frisch, the life and work of the German sensory physiologist and comparative psychologist Mathilde Hertz (1891-1975) have remained relatively obscure until recently. Her research represented a combination of biological principles fused with a psychological-phenomenological perspective. After a prolific career within a short time-span, Hertz's career came to an abrupt end in 1933, despite the intervention efforts of Max Planck. Hertz's personal and professional fate are in many ways representative for the field of comparative psychology in Germany prior to the middle of the twentieth century – both its history and its demise.

Rediscovering a Missing Link:

The Sensory Physiologist and Comparative Psychologist Mathilde Hertz (1891-1975)

Sprung and Sprung (1996) have pointed out that although it sounds trivial, women also contributed to the development of modern psychology in the German-speaking scientific community. Although women attained recognition on the merit of their own work as well as in some cases being helped through the eminence of their spouses (i.e., Rosa Katz, Charlotte Bühler), Mathilde Hertz (1891-1975) is one German female scholar whose work received less recognition than it deserves. Ironically and sadly, in the wake of World War II and after her emigration to England, her meager fame was based on England's perceived debt to her father, the physicist Heinrich Hertz (1857-1894), and not on the merit of her own scientific achievements (Jaeger, 1996).

The work and life of the comparative psychologist and sensory physiologist Mathilde Hertz are not only interesting in their own right, but they are representative of a range of political, social, and scientific developments which shaped the field of animal psychology around the turn of the twentieth century and subsequently the development of both comparative psychology and ethology in Germany prior to 1940. For example, Hertz's work is representative of the scientific comparative psychology being conducted in Germany prior to WWII in terms of methodology and conceptual orientation with her emphasis on *Gestalt* qualities in sensation and perception and her focus on ecological research paradigms. In this respect, her work typifies essential differences between German animal psychology in the first half of the twentieth century and North American comparative psychology as perceived by German animal psychologists. Furthermore, Hertz's research demonstrates the overlap of interest in topics by ethologists with training in biology or zoology and trained psychologists.

Nonetheless, in helping identify the distinction between purely biological versus psychological orientations, Hertz inevitably addressed the topic of comparative psychology as a viable and necessary field of research distinct from a purely biological study of animal behavior. Her career also reflected factors associated with the institutional and professional status of comparative psychology in Germany prior to 1940, in particular the fact that comparative psychology did not become institutionally established. Animal psychologists from biological and zoological disciplines, on the other hand, coalesced under the leadership of Carl Kronacher (1871-1937), Otto Koehler (1889-1974), and Konrad Lorenz (1903-1989) to form both a *Gesellschaft für Tierpsychologie* [Society for Animal Psychology] in 1936 and a corresponding *Zeitschrift für Tierpsychologie* [Journal of Animal Psychology] in 1937. Last but not least, due to her Jewish descent Hertz was susceptible to the political and racially-motivated policies instituted during the National Socialist regime that permanently altered the field of comparative psychology in Germany. Her personal fate, which was inevitably tied to her career, was analogous to those of other notable psychologists in the wake of political policies instituted prior to the outbreak of WWII.

Biographical Introduction

Biographical information about Mathilde Hertz has been sparse until fairly recently. The biographical information about Hertz in the following section is taken from Jaeger's appropriately entitled article, "*Vom erklärbaren, doch ungeklärten Abbruch einer Karriere – Die Tierpsychologin und Sinnesphysiologin Mathilde Hertz (1891-1975)*" (1996, pp. 229-262) [On the Accountable, Though Unaccounted for Abrupt End of a Career – The Animal Psychologist and Sensory Physiologist Mathilde Hertz (1891-1975)]. Mathilde Carmen Hertz was born on January 14, 1891 in Bonn, the younger of two daughters of the physicist Heinrich Hertz (1857-

1894), who died when Mathilde was three years old. After completing a non-classical secondary school education and attending various art academies, she began a career as sculptor. Because she could not support herself financially solely as an artist, she took a position in 1918 at the library of the German Museum (*Bibliothek des Deutschen Museums*) in Munich (Anonymous, 1992).¹ Initially her duties consisted of drawing and sculpting plastic reconstructions of fossilized teeth for the zoological collection. Overcoming barriers for a scientific career for women, she enrolled in 1921/22 at the University of Munich where Ludwig Döderlein (1855-1936) was director of the zoological collection. Figure 1 is a photograph of Mathilde Hertz in 1924 at the age of 33.

Insert Figure 1 about here

As a result of acquiring the skill of precise observation through her work in the zoological collection and hearing Döderlein's lectures her personal knowledge and interest in phylogenetic relationships grew. She eventually completed her doctoral degree under the supervision of Richard von Hertwig (1850-1937) with a dissertation about observations of primitive mammal teeth (Hertz, 1925).

Starting in 1925, and now influenced by Wolfgang Köhler's work, she began working in the field of animal psychology in Munich. Her subsequent contributions to comparative psychology reflected the orientation of Köhler with respect to the application of *Gestalt* psychological principles applied to the study of animal behavior. In 1927 she went to Berlin where the opportunities for independent researchers were better and received a position in the Kaiser Wilhelm Institute for Biology in the Department for Genetics and Biology of Animals under the direction of Richard Goldschmidt (1878-1958).

In 1929 she received a permanent position at the institute as an assistant to Goldschmidt and completed her *Habilitation* [post-doctoral thesis] on the organization of the optical field in honeybees using black and white figures. Citation of Hertz's work as well as examples of these figures were reprinted in an article by von Frisch (1937) in the first volume of the *Zeitschrift für Tierpsychologie* [Journal of Animal Psychology]. Whereas Karl von Frisch had concluded that bees do not discriminate between basic geometric forms, Hertz had determined that different visual stimuli represent qualitative variations for bees depending on the amount, degree, and distribution of contours. Wolfgang Köhler served as one of the committee members for her post-doctoral thesis. Apparently Köhler was so impressed with her work that he posed the rhetorical question, if it wouldn't be appropriate to require a second *Habilitation* from her (Jaeger, 1996, p. 240). Köhler valued Hertz's post-doctoral thesis as an important contribution to the development of *Gestalt* psychology.

In addition to working in Goldschmidt's lab Hertz held lectures and conducted seminars on the topic of experimental animal psychology at the Friedrich-Wilhelms University in the Zoological Institute in the fatefully-named *Invaliden Street* Nr. 43 until her authorization to teach was withdrawn in 1933 due to the enforcement of the "Law for the Restoration of Professional Civil Service." According to this law, civil servants who were not of 'Aryan descent' were to be retired, and those whose political stance did not guarantee loyalty to the Nazi regime to be dismissed (Geuter, 1992). Despite the intervention efforts of Max Planck (1858-1947), the president of the *Kaiser-Wilhelm Society* at that time, she was no longer able to teach although she continued to work in Goldschmidt's lab until the end of 1935. Between 1925 and 1935 she published more than 30 articles. Mathilde Hertz emigrated to England in January 1936 where she continued her work at Cambridge University in the Zoology Department until 1938 (Hertz & Imms, 1937). Thanks to the efforts of scholars,

institutions, and interested parties, who recognized the efforts of her father and felt that society had to take some responsibility for the family of such a great scientist, she received various stipends to help finance herself, mother, and older sister.

Her last publication in German concerning experimental methods in optical experiments with bees appeared in 1938. Shortly after that her scientific career came to an abrupt end. Although she once wrote in 1942 that she was too sick to continue research work, Jaeger (1996) has determined that personal reasons were more likely the cause of the abrupt end of her career. It appears, for example, that, unlike other members of her family, she remained loyal to Germany and never fully accepted the fact that she had been identified by the Nazis as a Jew and her employment terminated because of this (Jaeger, 1996). She never applied for naturalization and the fact that she remained a German citizen was probably a major disadvantage in receiving a permanent position or continuing her work in England (Jaeger, 1996). It has also been suggested that while in England, Hertz was “like a fish out of water” (V. Sarris, personal communication, March 3, 2003). Unlike her mentors Wolfgang Köhler and Max Wertheimer, she didn’t possess a strong enough personality to assert herself under the new circumstances following her emigration (V. Sarris, personal communication, March 3, 2003). In any case, she lived the remainder of her life fairly isolated and in relative poverty, too proud to accept charitable contributions intended for her solely on the basis of being Heinrich Hertz’s daughter (Jaeger, 1996).

Scientific Contributions to Animal Psychology and Sensory Physiology

The last entry for Mathilde Hertz in the German scholars calendar in 1933, *Kürschners Gelehrtenkalender*, lists her as an “animal psychologist and sensory physiologist.” Like the eminent ethologist Karl von Frisch, who specialized in studying the observable behavioral

manifestations of the psychology of bees and was one of the founding editors of the *Zeitschrift für vergleichende Physiologie* [Journal of Comparative Physiology], Hertz also conducted sensory studies with honeybees, particularly with regard to their visual perception of colors, forms, and patterns.

Early in her career Hertz worked with birds, but since their visual abilities were just as advanced as those of anthropoids, she later decided to study a more primitive form, namely the bee (Anonymous, 1992). Contrary to the findings of Karl von Frisch that bees did not possess a genuine sense of shape because they could not distinguish between triangles and circles, Hertz had determined in her post-doctoral thesis that honeybees in fact preferred forms full of contour. Hertz minimized the use of conditioning or training (German word *Dressur*) in her research designs in order to keep learned responses to a minimum. Initially von Frisch had observed that bees differentiated characteristic illustrations of flowers, although they could not distinguish among basic geometric shapes. Hertz (1935) proposed that the successful conditioning of the bees to the flowers but not the forms could be explained by a hereditary (instinctive) recognition of flower stimuli. Hertz modified von Frisch's method and apparatus, particularly by eliminating the conditioning of the bees prior to the experiments. Hertz (1931) covered a table with different black and white figures varying in form and degree of contour, and placed bowls of sugar water between the forms. She then observed flight patterns relative to the forms (i.e., which sources of food next to which form were frequented by most bees, most often, and most quickly). Realizing that conditioning to a particular stimulus occurs automatically through preferences developed over the course of a few trials, Hertz then attempted to condition the bees to a particular form. The relative resistance to conditioning to a particular stimulus was, in Hertz's estimation, a good measure of the kind and degree of spontaneous responding (Hertz, 1935).

Insert Figure 3 about here

Hertz was able to determine visual preferences in bees with regard to patterns. She coined the term “figural intensity” to designate the visual quality of a figure – the more differentiated (i.e., more figures) and the more pronounced the contours, the greater the preference of bees for those figures. “Figural quality” referred to the type of figure (i.e., rounded versus pointed). Figure 3 shows reprints of sample stimuli varying in figural quality and figural intensity.

In another article on the visual organization of bees, Hertz (1931) used variations of different forms and patterns to test bees’ perception of depth, contrast, and patterns as well as presenting the stimuli at different times of the day to study light and shadow effects. Figure 4 shows photographs of stimuli employed to test three-dimensional vision in bees, particularly during flight approaching a stimulus.

Insert Figure 4 about here

Although largely known for her work with bees, Hertz conducted studies with a variety of different animal species including blue jays, ravens, houseflies, wasps, and hermit crabs to mention a few different species. Hertz’s work on the visual perception of jays – pre-dating her work with honeybees - exemplifies the origins of her conceptual and methodological orientation. Hertz’s experiments with jays were explicitly conceived and designed to examine the *Gestalt* laws of perceptual organization outlined by Wertheimer (1923) (Hertz, 1928a).

In her experiments on the visual perception of blue jays, Hertz altered the location of objects within identical configurations so that she was able to determine, among other things, how jays distinguish between concave and convex stimuli. The method employed by Hertz with jays was later implemented in studies with primates (e.g., Bierens de Haan, 1929-30). Based on the assumption that blue jays have only a weak sense of smell and that there was no stimulus originating from the hidden object, Hertz reasoned that the bird has to depend on memory and sensory input to locate the critical area subsequently and retrieve its bounty by removing debris hiding the food (Hertz, 1928a, b). Hertz (1928a) pointed out that in biological-physiological journals the terms *Erinnerungsbilder* [pictures in memory] or *Vorstellungen* [images] are used in conjunction with such problems, but she claimed that it had been proven psychologically that comparison and recognition are not tied to the literal appearance or occurrence of ideas. The basis of comparison for the current perception is not a picture in memory or conception of an earlier perception, but rather an occurrence of a physiological residue from a perception that is not consciously retrievable (Hertz, 1928a).

Derived from similar experiments which Köhler had employed with anthropoids, Hertz hid food (i.e., a peanut or hazelnut) while the bird was watching and then observed the bird's behavior. This was Hertz's solution for inducing the bird to engage in searching behavior that was not necessary for its survival in a laboratory setting (Hertz, 1928a). Initially the food was covered with a flowerpot as the birds watched. After the birds had learned this exercise, the goal objects and obstacles could be modified to match the bird's natural environment, such as using stones, wood, or grass. Hertz (1928a, b) implemented a countless variety of stimulus constellations to detect which variables were essential for finding the hidden food. In order to rule out the possibility that the birds were responding on the basis of

conditioning, Hertz incorporated critical trials in which both the target (food) and intermediate target (object hiding the food) were absent during the search phase.

Hertz (1928a) determined that birds picked an object under which the reward was hidden based on the degree of convexity of the object, as compared to similar objects, and not on other visual cues in the surroundings. Having determined that, the question remained as to which physiological correlates play a role in such perceptual discrimination, such as the perception of shadows or light distribution. The fact that convexity was an essential visual cue seemed to be consistent with factors in their natural behavioral repertoire, such as jumping or flying from branch to branch and their capacity for depth perception. Hertz pointed out a host of questions that arise from such a scenario – How long does the memory retain such information? Which factors play a role in recognition of the critical area? What is the relation between these factors and the rest of the similar environment? Hertz (1928a, p. 146) discounted a “clever, mechanistic” explanation proposed by some colleagues that the jays’ searching behavior was the result of a program that is activated when the bird hides the food and which triggers the appropriate movements in a particular direction toward the food cache when the bird is hungry.

Contrary to researchers who totally denounced the use of analogy in animal psychology research, Hertz (1933) claimed that although humans and bees have a totally different visual perception of their environment, statements about the perception of experimental animals can only be made by assuming certain fundamental similarities in perceptual processes. Based on this assumption, experiments can be designed to either support or negate the validity of such analogies. By determining the limitations in experimental animals we gain knowledge about the effectiveness of other organisms in comparison with our own. Perhaps for this reason she stated dogmatically and unequivocally that, “*Es ist keine Sinnesphysiologie möglich, die nicht zunächst*

und auf eine weite Strecke hin vergleichende Psychologie wäre und nichts als dieses," (1933, p. 12) [No sensory physiology is possible, that wouldn't immediately or in the long run be comparative psychology and nothing but this]. Hertz was referring to the fact that both explicit and implicit interspecies comparisons are inevitable in sensory physiology. She added that experiments begin without exception by observing the behavior of animals toward objects which we perceive and are familiar with based on our own experience (ourselves as a frame-of-reference). We then proceed to draw conclusions about the animals' perception of this encounter as compared to our own (Hertz, 1933). The defensive tone of Hertz's statement underlines the precarious position of comparative psychologists within animal research at that time and Hertz's identification of herself as a comparative psychologist.

Hertz (1933) stated the imperative for comparative psychology in her article on the figural intensities and qualities in the optical perception of bees. Although a stimulus is defined or interpreted as an external event causing changes in behavior, there is the temptation to quickly infer that one particular stimulus was the cause of a reaction. Hertz pointed out, however, that a stimulus is actually as complex (i.e., has many different qualities) as the reaction, which is in itself actually a chain of events triggered by the stimulus. For example, the visual perception of a moving stimulus can produce different images on the retina (e.g., the same optical stimulus can trigger different reactions). Hertz claimed that biologists are limited in accounting for these differences presumably because they neglect the phenomenological aspects or relational character of sensory perception.

Nonetheless, in a departure from other psychologists working in the field of animal psychology, including Wolfgang Köhler, Hertz did not discount the role of instinct in helping shape behavior. In an essay originally published in French in 1937 and re-edited from a German translation by Siegfried Jaeger, Hertz elaborated on the relationship between instinct

and intelligence in the animal kingdom. Because the essay appeared so late in her professional career, it reflects the culmination of her views regarding animal behavior in light of her research up to that point in time. She pointed out in the essay that instinct and intelligence were originally thought to be mutually exclusive, but new reports about intelligent behavior in animals had led to questions regarding the relationship between the two (Hertz, 1937). In this respect, Hertz differed from Wolfgang Köhler in refusing to discount the role of instinct in animal behavior and in her insistence about the “inevitability of the concept of instinct in biology” (Jaeger, 1996, p. 240). This was the topic of a controversy between the two, as indicated by correspondence between them (Jaeger, 1996).

The Gestalt Influence in Hertz's Animal Psychology

Hertz's work was representative of animal psychology as a whole in Germany in the 1920s and 1930s, which in turn was shaped largely by Wolfgang Köhler's work with chimpanzees at the anthropoid station in Tenerife from 1913-1920. Köhler's work had a tremendous heuristic effect on animal research in a number of different ways, which is illustrated very well by Hertz's work. For one thing, based in part on Köhler's experiments in Tenerife, a generation of experimental work was created which dealt with animals' acquisition of food (i.e., overcoming barriers, finding hidden sources, etc.). Several of Hertz's articles including both articles on the psychological-perceptual experiments with jays (1928a, b) and an article about the behavior of bees towards flowers with inaccessible sources of nectar (1934) were based on the fact that animals hide and store food for later retrieval, or must overcome barriers or obstacles to find food. Hertz (1928a) had stated explicitly that her work with jays was based on Wolfgang Köhler's experiments with chimpanzees.

Another aspect of Köhler's legacy was evident in Hertz's conceptual orientation and methodological approach. Hertz recognized that there are peripheral factors in the environment that play a role in determining behavior that are frequently overlooked. Hertz (1928a) was interested in how the birds perceive the *Gesamtconfiguration* [total configuration] or *Gestalt* in order to test the bird's discriminating ability for different factors and variables. The goal of comparative psychology should be to discover the laws explaining the relationship between external, objective conditions and events and inner constitution (Hertz, 1933). As Hertz pointed out, there are a number of different factors in an optical event which play a role in visual perception including the energy deployed to the receptors, the retinal constitution, the totality of size and geometrical positions of visual stimuli and their interaction with one another, and the totality of temporal factors in combination with the size and position of stimuli, to name a few.

Like Wolfgang Köhler before her, Hertz employed careful experimental methods that did not disregard the constraints of animals' native habitats or ecological requirements for survival. She earned praise from both the professor of animal psychology Friedrich Alverdes (1906-1952) and the biologist Richard Hesse (1868-1944), who stated that her research topics and methodology on jays – in contrast to the North American behaviorist school – conformed to the animal (Jaeger, 1996). Richard Hesse pointed out in a testimonial regarding Hertz's application for a teaching post in Zoology, that her work was a hybrid between sensory psychological experiments by biologists and research into perception and cognition by psychologists and an attempt to join the two, clearly demonstrating "...how unproductive a lack of coordinated mutual effort could prove to be," (Anonymous, 1992, p. 2).

Finally, the vast number of potential stimuli configurations in the study of any given perceptual event necessarily led to an experimental design, which was not only typical for

German animal psychology in the first half of the twentieth century, but is also reflected in the publications of *Gestalt* psychologists (cf. Wertheimer, 1923). Articles in the field of animal psychology frequently reported on a countless number of experiments based on minor variations of an experimental configuration (Bierens de Haan, 1929-30; Hertz, 1930, 1931). For example, in an article on the organization of the visual field of bees, Hertz (1930) provided a summary of 350+ experiments based on numerous variations of the stimulus forms, sizes, colors, distances to one another, etc. Hertz called it a “protocol,” but the experiments are numbered and clearly reflect the manipulation of an independent variable in order to observe changes in flight behavior. The follow-up article in 1931 was similar as were her earlier articles with jays (Hertz, 1928a, b).

Hertz’s work represented a fusion between biological and ecological principles and psychological-phenomenologically oriented experimental methods and interpretations to bridge the gaps left by a sensory physiology that did not consider perception and cognition. The psychological-phenomenological analysis and experimental stance taken by *Gestalt* psychologists placed emphasis on describing and discovering laws regulating perceptual organization as part of a larger reality in contrast to more reductionistic or mechanical approaches in biology or comparative psychology at the time (i.e., behaviorism, trial-and-error learning), which disregarded the relational nature of perception itself (Ash, 1995). For Hertz, *Gestalt* theory supplied both the psychological theory of perceptual experiences and experimental method needed in order to understand the physiological correlates of organized perceptual contents better.

Although influenced significantly by *Gestalt* psychologists, it is important to stress that Hertz was not merely following a trend, but that she conducted pioneering work in her study of *Gestalt* principles in relation to animal perception, the results of which both Köhler and

Wertheimer deemed as very important contributions to the further development of *Gestalt* theory (Jaeger, 1996; V. Sarris, personal communication, March 3, 2003). Her work was for that time quite *avante garde*. Hertz's research continued to be important for *Gestalt* psychologists (V. Sarris, personal communication, February 25, 2003). Karl Duncker (1936/1945), for example, discussed Hertz's work with ravens and the central importance of these findings in conjunction with problem-solving behavior. Metzger (1975) mentioned Hertz's work with jays with regard to the laws of vision, using her experiments to illustrate a test of the laws of grouping or proximity.

The Institutional Status of Comparative Psychology Prior to 1940

Hertz's work is representative of the status of German comparative psychology from 1900-1940 with respect to terminology, content, methodology, and institutional status. The work of psychologists and biologists conducting empirical studies in animal behavior was not referred to collectively by any one particular term although it fell under the generic term of *Tierpsychologie* [animal psychology]. This was somewhat unfortunate because it was not distinguishable, in the use of this term, from the popular animal psychology at that time (Abresch & Lück, 1994). On the other hand, the term 'comparative psychology' was used to connote a comparative method involving animal psychology, abnormal psychology, child psychology, and cultural psychology, which was unique to the field of psychology in Germany prior to 1940 and was limited to psychologists (Kressley-Mba, 2001).

A factor in Germany which differentiated comparative psychologists from early ethologists and comparative psychologists in North America was the degree of specialization regarding the field of animal psychology. There were few psychologists in Germany who specialized in animal psychology compared to colleagues in biology, who devoted an entire career to observing and studying the behavioral manifestations of animals. This was partly due to

the status of experimental psychology in Germany around the turn of the twentieth century. Until 1910, experimental psychology was an area of research within the philosophy faculty and had not yet gained the status of an independent discipline (Ash, 1990). Experimental psychologists were faced with two challenges: legitimizing their work and methods to colleagues in both the natural sciences and within the philosophy faculty as well as demonstrating the viability and potential practical usefulness of their work to state officials (Ash, 1990). Aware of these demands, scholars were possibly reluctant to declare psychology, much less animal psychology, as their specialty (e.g., Katz, 1952/1968, p. 194; Köhler, in Jaeger, 1988, p. 16). The lack of recognition granted psychologists for their contribution to animal psychology is demonstrated, for example, by Lorenz's (1937) scathing criticism of psychologists' work in the field of animal psychology, despite later acknowledging their invaluable contributions (Lorenz, 1959). In addition, the defensive tone taken by psychologists justifying their methods in animal psychology (e.g., Hertz, 1933; Kafka, 1922; Katz, 1937), the rejection of work by colleagues (e.g., Kafka, see Wehner, 1964), and the indifferent reaction of certain biologists to work in animal psychology (e.g., Goldschmidt's reaction as a mere, "why not?" to Hertz's post-doctoral thesis on the optical field of bees, see Jaeger, 1996, p. 238) were further examples of the opposition psychologists faced.

Hertz's career is an early example of comparative psychologists who conducted their work as adjuncts to Biology Departments, one indirect consequence of the lack of professional institutional status of animal psychology among psychologists. Considering the absence of interest in her work by her supervisor Goldschmidt, Hertz was fortunate to work under the auspices of the university. Goldschmidt was busy with his own research in genetics at the time and had little interest for research in animal sensation and perception (Jaeger, 1996). This may also be the reason he neglected to mention Hertz in any of his autobiographical works (Jaeger,

1996). A special building was constructed for her experiments and she was largely freed from academic responsibilities so that she could pursue her research. Upon completion of her post-doctoral thesis, she was awarded tenure for “Zoology” – and not, as requested, for “*Zoology, with Special Consideration of Animal Psychology*” (Jaeger, 1996, p. 240). A continuation of this trend was evident later once departments and institutes of comparative psychology were formally established at German universities. They were chaired by scholars with a background in biology or zoology, such as Konrad Lorenz, Friedrich Alverdes, or Werner Fischel.

Professional journals represent another index of institutional status. Work in comparative psychology was not published in one journal specializing in such topics but was frequently published in biological journals or dispersed within the German psychological journal literature. Hertz’s first articles about jays were published in the *Gestalt* psychology journal *Psychologische Forschung* [Psychological Research]. Thereafter her work appeared in biological periodicals, foremost in the *Journal of Comparative Physiology*, edited by Karl von Frisch, Erich von Holst, and H. H. Weber, and the *Biologisches Zentralblatt* [Biological Newsletter] edited by C. Correns, R. Goldschmidt, and O. Warburg.

Despite these institutional limitations, psychologists conducting work in animal psychology in Germany prior to 1940 actually had more in common with biologists in terms of conceptual orientation and methodology, than is frequently acknowledged in historical accounts of the development of ethology. German psychologists and biologists were unified in their opposition to North American behaviorism, evident both in Hesse’s appraisal of Hertz’s work and Hertz’s own criticism of behaviorism. It is evident, for example, that German biologists conducting experiments in animal psychology were influenced by the *Gestalt* and *Ganzheit* orientation of psychologists (Lorenz, 1959, 1992²; Wuketits, 1995). As Ash (1984) pointed out, North American behaviorism was not conducive to a philosophically oriented psychology of

consciousness. To this effect both strands of animal psychology in Germany had more in common with each other than either of the two with North American behaviorism

Ultimately, ethology (biologically-based comparative animal behavior research) was more successful in securing institutional status within the academic community and society as a whole. Although ethologists have made significant contributions to the area of animal behavior, an achievement recognized officially with the Nobel Prize for Tinbergen, von Frisch, and Lorenz in 1973, many of the early circumstances contributing to ethology's institutional success were not necessarily scientific in nature. Ethology did not become institutionally differentiated from comparative psychology until 1936 at which time there was an obvious effort on the part of biologists to present themselves as distinct from 'popular' animal psychology *and* comparative psychology. It seems that biologists were free from certain academic and professional burdens hampering psychologists, for example, having to defend their work to colleagues. Furthermore, the field of psychology suffered from a massive loss of personnel after WWI and again later due to the Nazi regime. The effects of racial and political policies instituted during the Hitler dictatorship eliminated many psychologists who either conducted empirical studies in animal psychology, or those who incorporated elements of animal psychology into their work and thereby reinforced its validity within the discipline (i.e., Karl Bühler, Adhemar Gelb, Hans Henning, Erich von Hornbostel, Gustav Kafka, David Katz, Wolfgang Köhler, Kurt Koffka, Felix Krueger, Otto Selz, and Max Wertheimer) (Kressley-Mba, 2001). The establishment of a *Society for Animal Psychology* and a corresponding journal in 1937 coincides roughly with the time of a massive exodus of German psychologists. A secondary effect of WWII on comparative psychology was the professionalization of psychology. This reduced the ranks of personnel conducting pure research when the immediate needs of society had to be met, for example, through the development of military psychology.

Concluding Remarks

After withdrawal of her teaching permit in 1933 Mathilde Hertz seems to have capitulated. In response to Max Planck's efforts to intervene on her behalf, she wrote him and asked him not to undertake any further actions regarding her situation. She did not accept an invitation from Columbia University in 1933, although she decided one year later to emigrate to England. Another offer was made to her by John Paul Nafe (1886-1970), Professor of Psychology at Washington University in St. Louis, later at Florida State University, whom she probably met during his time as a Guggenheim Fellow in Berlin in 1930 (Anonymous, 1992). Her students and co-workers in Berlin, who might otherwise have continued her legacy in Germany, such as Walter Schaff (1933), Jakob Segall (1933), Dora Ilse (1929a, b; 1932), and Mercedes Gaffron (1934; 1950 a, b), were scattered throughout different parts of the world in the wake of World War II. The potential impact of Hertz's work, which was never fully realized due to the abrupt end of her work, is illustrated by the career of one of her students.

Mercedes Gaffron completed her dissertation in 1934 on the vision of movement in invertebrates and fish under Hertz's supervision and continued comparative experimentation on stroboscopic vision. Wolfgang Köhler took an interest in Gaffron's work and she went on to carry out parallel experiments with humans at the Institute of Psychology at the University of Berlin (Jaeger, 1996). These studies were apparently so important for *Gestalt* psychologists that Max Wertheimer, who was in exile at the time, inquired about the progress of Gaffron's work and used the occasion to invite Mathilde Hertz to give a lecture in the USA (Jaeger, 1996).

After the war Gaffron emigrated first to Peru and then in 1948 to the U.S. to take a position in the Department of Psychology Department at Duke University where she worked with Karl Zener (1903-1964) (S. Jaeger, personal communication, July 24, 2001). In a chapter on "Perceptual Experience" in Sigmund Koch's (1962) *Psychology: A Study of Science* Gaffron, in

collaboration with Zener, summarized and discussed theoretical implications of her earlier works on the phenomenological attributes and structure of spatial perception. The bond to *Gestalt* psychology remained intact and was also evident in her work in the field of psychology of art and the asymmetry of visual perception (Gaffron, 1950a, b).

Despite being very prolific within a relatively short time-span and having earned the recognition of prominent figures in animal psychology from both the field of psychology and biology, such as Wolfgang Köhler, Otto Koehler (see Jaeger, 1996, p. 233), Karl von Frisch, and Max Wertheimer, it is strange that Hertz has received so little recognition in the scientific literature. Jaeger (1996) has suggested that the shift from animal psychology to ethology around 1940, which focused more on instinctive behavior, made Hertz's phenomenologically-oriented analyses obsolete within the field. This is consistent with the general development of animal psychology in Germany subsequent to 1940, but it still does not explain why Mathilde Hertz is virtually nonexistent in standard reference works about psychologists or scholars. For example, Geuter (1986), who compiled a fairly comprehensive collection of data about German psychology from a variety of standard reference works, was unable to provide biographical or professional information about Mathilde Hertz after the year 1933 and did not report a date of death. This indicates the extent of paucity of biographical information about her until recently. Despite numerous publications and citation of her work by eminent colleagues, there are only three entries in the *National Union Catalogue 1911-1965* for her work – and these are publications originating from early in her career and not pertaining to animal psychology. This misrepresentation of her work is particularly unfortunate, because she certainly would have wanted to be remembered first and foremost as a comparative psychologist.

References

- Abresch, J., & Lück, H. E. (1994). Der kluge Hans, Oskar Pfungst und die Hirnrinde [Clever Hans, Oskar Pfungst, and the Brain Cortex]. In H. Gundlach (Ed.), *Arbeiten zur Psychologiegeschichte* (pp. 83-94). Göttingen: Hogrefe.
- Anonymous (1992). The short career of an animal psychologist: Mathilde Hertz (1891-1975).
- Ash, M. G. (1984). Psychologie in der Weimarer Zeit [Psychology during the Weimar period]. In H. E. Lück, R. Miller, & W. Rechten (Eds.), *Geschichte der Psychologie: Ein Handbuch in Schlüsselbegriffen* (pp. 20-22). Munich: Urban & Schwarzenberg.
- Ash, M. G. (1990). Die experimentelle Psychologie an den deutschsprachigen Universitäten von der Wilhelminischen Zeit bis zum Nationalsozialismus [Experimental psychology at German-language universities from the Wilhelminian period until National Socialism]. In H. E. Lück, & R. Miller (Eds.), *Theorien und Methoden psychologiegeschichtlicher Forschung* (pp. 45-82). Göttingen: Hogrefe.
- Ash, M. G. (1995). *Gestalt Psychology in German Culture, 1890-1967*. New York: Cambridge University Press.
- Bierens de Haan, J. A. (1929-30). Über das Suchen nach verstecktem Futter bei Affen und Halbaffen. Zugleich ein Beitrag zu der Frage nach dem konkreten Verständnis dieser Tiere [On the search for hidden food in monkeys and prosimians. Also a contribution to the question about the concrete comprehension of these animals]. *Zeitschrift für vergleichende Physiologie*, 11, 630-655.
- Duncker, K. (1945). On problem-solving (L. S. Lees, Trans.). *Psychological Monographs*, 58 (5, Whole No. 270).
- Frisch, K. von (1937). Psychologie der Bienen [Psychology of bees]. *Zeitschrift für Tierpsychologie*, 1, 9-21.

- Gaffron, M. (1934). Untersuchungen über das Bewegungssehen bei Libellenlarven, Fliegen und Fischen [Studies on the visual perception of movement in dragonfly larvae, flies, and fish]. *Zeitschrift für vergleichende Physiologie*, 20, 299-337.
- Gaffron, M. (1950a). Die Radierungen Rembrandts, Originale und Drucke. Studien über Inhalt und Komposition [The etches of Rembrandt, originals and prints. Studies on content and composition]. Mainz.
- Gaffron, M. (1950b). Right and left in pictures. *Art Quarterly*, 13, 312-331.
- Geuter, U. (1992). *The professionalization of psychology in Nazi Germany*. Cambridge: Cambridge University Press.
- Geuter, U. (Ed.). (1986). *Daten zur Geschichte der deutschen Psychologie. Psychologische Institute, Fachgesellschaften, Fachzeitschriften und Serien, Biographien, Emigranten 1879-1945* (Bd. 1) [Data on the history of German psychology. Psychological institutes, professional societies, professional journals and serials, biographies, immigrants 1879-1945, Vol. 1]. Göttingen: Hogrefe.
- Hertz, M. (1925). Beobachtungen an primitiven Säugetiergebissen [Observations of primitive mammalian jawbones]. *Zeitschrift für Morphologie und Ökologie der Tiere, Abt. A, Bd. 4*, 540-584.
- Hertz, M. (1928a). Wahrnehmungspsychologische Untersuchungen am Eichelhäher I. [Sensation and perception experiments on jays. I.]. *Zeitschrift für vergleichende Physiologie*, 7, 144-194.
- Hertz, M. (1928b). Wahrnehmungspsychologische Untersuchungen am Eichelhäher II. [Sensation and perception experiments on jays. II.]. *Zeitschrift für vergleichende Physiologie*, 7, 617-656.

- Hertz, M. (1930). Die Organisation des optischen Feldes bei der Biene. II. [The organization of the optic field in the bee. II.]. *Zeitschrift für vergleichende Physiologie*, 11, 107-45.
- Hertz, M. (1931). Die Organisation des optischen Feldes bei der Biene. III. [The organization of the optic field in the bee. III.]. *Zeitschrift für vergleichende Physiologie*, 14, 629-674.
- Hertz, M. (1933). Über figurale Intensitäten und Qualitäten in der optischen Wahrnehmung der Biene [Concerning the figural intensities and qualities in the optical perception of bees]. *Biologisches Zentralblatt*, 53, 10-40.
- Hertz, M. (1934). Zum Verhalten der Bienen gegenüber Blüten mit verborgener Nektarquelle [Concerning the behavior of bees towards flowers with inaccessible sources of nectar]. *Biologisches Zentralblatt*, 54, 508-511.
- Hertz, M. (1935). Die Untersuchungen über den Formensinn der Honigbiene [The experiments on the sense of form in honeybees]. *Die Naturwissenschaften*, 23, 618-24.
- Hertz, M. (1937). Die Beziehungen von Instinkt und Intelligenz im Tierreich [The relation between instinct and intelligence in the animal kingdom]. *Journal de Psychologie Normale et Pathologique*, 34, 324-341. (Originally translated into German by Gisela Haus and edited later by S. Jaeger.)
- Hertz, M., & Imms, A. D. (1937). On the responses of the African migratory locust to different types of background. *Proceedings of the Royal Society of London – Series B – Biological Sciences*, 122, 281-297.
- Ilse, D. (1932). Zur „Formwahrnehmung“ der Tagfalter [On the perception of form in butterflies]. *Zeitschrift für vergleichende Physiologie*, 17, 537-556.
- Ilse, D. (1929a). Über den Farbensinn der Tagfalter [On the color sense in butterflies]. *Forschungen und Fortschritte*, 5, 387-389.

- Ilse, D. (1929b). Über den Farbensinn der Tagfalter [On the color sense in butterflies].
Zeitschrift für vergleichende Physiologie, 8, 658-692.
- Jaeger, S. (Ed.). (1988). *Briefe von Wolfgang Köhler an Hans Geitel 1907-1920* [Letters from Wolfgang Köhler to Hans Geitel 1907-1920]. Passau: Passavia Universitätsverlag.
- Jaeger, S. (1996). Vom erklärbaren, doch ungeklärten Abbruch einer Karriere – Die Tierpsychologin und Sinnesphysiologin Mathilde Hertz (1891-1975) [On the accountable, though unaccounted for abrupt end of a career – The animal psychologist and sensory physiologist Mathilde Hertz (1891-1975)]. In H. Gundlach (Ed.), *Untersuchungen zur Geschichte der Psychologie und der Psychotechnik* (pp. 229-262). Munich, Germany: Profil Verlag.
- Kafka, G. (Ed.). (1922). *Handbuch der vergleichenden Psychologie* (Bd. 1) [Manual of comparative psychology, Vol. 1]. München: Ernst Reinhardt.
- Katz, D. (1937). *Animals and men: Studies in comparative psychology*. London: Longmans, Green. (Reprint in 1971)
- Katz, D. (1952/1968). David Katz. In E. G. Boring, H. S. Langfeld, H. Werner, & R. M. Yerkes (Eds.), *History of psychology in autobiography* (Vol. 4, pp. 189-211).
- Kressley-Mba, R. (2001). *The history of animal psychology in Germany as an antecedent to German comparative psychology and ethology prior to 1940 with special emphasis on nonhuman primates*. Unpublished doctoral dissertation, Passau University, Passau, Germany.
- Lorenz, K. (1937). Biologische Fragestellungen in der Tierpsychologie [The biological question in animal psychology]. *Zeitschrift für Tierpsychologie*, 1, 24-32.

- Lorenz, K. (1959). Gestaltwahrnehmung als Quelle wissenschaftlicher Erkenntnis [*Gestalt perception as a source of scientific knowledge*]. *Zeitschrift für experimentelle und angewandte Psychologie*, 6, 118-165.
- Lorenz, K. (1992). *Die Naturwissenschaft vom Menschen: Eine Einführung in die vergleichende Verhaltensforschung. Das "russische Manuskript" (1944-1948)* [The natural science of the human species: An introduction to comparative behavioral research: The Russian manuscript (1944-1948)]. Munich: Piper. (English translation by Robert D. Martin in 1996)
- Metzger, W. (1975) *Gesetze des Sehens [Laws of vision]*. Frankfurt am Main: Waldemar Kramer.
- Schaff, W. (1933). Raum- und Materialunterscheidung bei der grauen Hausmaus [Space and substance differentiation in the domestic gray mouse]. *Zeitschrift für vergleichende Physiologie*, 18, 622-653.
- Segall, J. (1933). Versuche über Lichtreaktionen und Lichtempfindlichkeit beim Regenwurm [Experiments on reactions to light and light sensitivity in earthworms]. *Zeitschrift für vergleichende Physiologie*, 19, 94-109.
- Sprung, H., & Sprung, L. (1996). Frauen in der Geschichte der Psychologie – Integrationsformen in die Psychologie und Vortragsaktivitäten auf deutschen Psychologiekongressen 1904-1978 [Women in the history of psychology – Forms of integration in psychology and presentation activities at German psychology conferences 1904-1978]. In H. Gundlach (Ed.), *Untersuchungen zur Geschichte der Psychologie und der Psychotechnik* (pp. 205-222). Munich, Germany: Profil Verlag.

- Wehner, E. G. (1964). *Gustav Kafka: Ein Beitrag zur Geschichte der Psychologie* [Gustav Kafka: A contribution to the history of psychology]. Unpublished dissertation, Julius-Maximilians-University Würzburg.
- Wertheimer, M. (1923). Untersuchungen zur Lehre von der Gestalt [Studies on the theory of Gestalt]. *Psychologische Forschung*, 4, 301-350.
- Wuketits, F. M. (1995). *Die Entdeckung des Verhaltens: Eine Geschichte der Verhaltensforschung* [The discovery of behavior: A history of behavioral research]. Darmstadt: Wissenschaftliche Buchgesellschaft.

Appendix

Bibliography of Mathilde Hertz's Work

- Hertz, M. (1925). Beobachtungen an primitiven Säugetiergebissen [Observations of primitive mammalian jawbones]. *Zeitschrift für Morphologie und Ökologie der Tiere, Abt. A, Bd. 4*, 540-584.
- Hertz, M. (1926a). Beobachtungen an gefangenen Rabenvögeln [Observations of captive ravens]. *Psychologische Forschung, 8*, 336-397.
- Hertz, M. (1926b). Herluf Wings Verdienste um die vergleichende Morphologie der Säugetierzähne. (Nachtrag zu meiner Arbeit über primitive Säugetiergebisse) [Herluf Wings' merits in the comparative morphology of mammal teeth (Supplement to my work on early mammal jawbones)]. *Zeitschrift für Morphologie und Ökologie der Tiere, Abt. A, Bd. 6*, 78-82.
- Hertz, M. (1927). Bewegungen von Kohlweisslingen über einem Felde [Movements of cabbage butterflies over a field]. *Biologisches Zentralblatt, 47*, 569-570.
- Hertz, M. (1928a). Wahrnehmungspsychologische Untersuchungen am Eichelhäher I. [Sensation and perception experiments on jays. I.]. *Zeitschrift für vergleichende Physiologie, 7*, 144-194.
- Hertz, M. (1928b). Wahrnehmungspsychologische Untersuchungen am Eichelhäher II. [Sensation and perception experiments on jays. II.]. *Zeitschrift für vergleichende Physiologie, 7*, 617-656.
- Hertz, M. (1928c). Weitere Versuche an Rabenkrähe [Further experiments on ravens]. *Psychologische Forschung, 10*, 111-114.
- Hertz, M. (1929a). Das optische Gestaltproblem und der Tierversuch [The optical *Gestalt* problem and animal experiments]. *Zoologischer Anzeiger Supplement, 4*, 23-49.

- Hertz, M. (1929b). Die Organisation des optischen Feldes bei der Biene. I. [The organization of the optic field in the bee. I.]. *Zeitschrift für vergleichende Physiologie*, 8, 693-748.
- Hertz, M. (1930). Die Organisation des optischen Feldes bei der Biene. II. [The organization of the optic field in the bee. II.]. *Zeitschrift für vergleichende Physiologie*, 11, 107-45.
- Hertz, M. (1931a). Die Organisation des optischen Feldes bei der Biene. III. [The organization of the optic field in the bee. III.]. *Zeitschrift für vergleichende Physiologie*, 14, 629-674.
- Hertz, M. (1931b). Rezension [Review]: I. P. Pavlov, Conditioned reflexes. An investigation of the physiological activity of the cerebral cortex. Oxford University Press, 1927. *Biologisches Zentralblatt*, 51, 461-464.
- Hertz, M. (1932). Neue Versuche über das Gedächtnis der Honigbiene für Strukturen [New experiments on the memory of honeybees for structures]. *Biologisches Zentralblatt*, 52, 436-444.
- Hertz, M. (1933a). Der Formensinn der Biene [The sense of form in bees]. *Forschungen und Fortschritte*, 9, 146-147.
- Hertz, M. (1933b). Enttäuschung und Erwartung beim Einsiedlerkrebs [Disappointment and expectation in hermit crabs]. *Forschungen und Fortschritte*, 9, 221-222.
- Hertz, M. (1933c). Über das Verhalten des Einsiedlerkrebses *Clibanarius misanthropus* gegenüber verschiedenen Gehäuseformen [Concerning the behavior of the hermit crab *Clibanarius misanthropus* when confronted with various forms of receptacle]. *Zeitschrift für vergleichende Physiologie*, 18, 597-621.
- Hertz, M. (1933d). Über figurale Intensitäten und Qualitäten in der optischen Wahrnehmung der Biene [Concerning the figural intensities and qualities in the optical perception of bees]. *Biologisches Zentralblatt*, 53, 10-40.

- Hertz, M. (1934a). Rezension: Wolfgang Köhler: Psychologische Probleme. Berlin: Springer 1933 [Review of Wolfgang Köhler's work: Psychological problems]. *Die Naturwissenschaften*, 22, 46-47.
- Hertz, M. (1934b). Zum Verhalten der Bienen gegenüber Blüten mit verborgener Nektarquelle [Concerning the behavior of bees towards flowers with inaccessible sources of nectar]. *Biologisches Zentralblatt*, 54, 508-511.
- Hertz, M. (1934c). Zur Physiologie des Formen- und Bewegungssehens. I. Optomotorische Versuche an Fliegen [Concerning the physiology of vision of form and movement. I. Optomotoric experiments on flies]. *Zeitschrift für vergleichende Physiologie*, 20, 430-449.
- Hertz, M. (1934d). Zur Physiologie der gesehenen Bewegung [Concerning the physiology of seen movement]. *Biologisches Zentralblatt*, 54, 250-264.
- Hertz, M. (1935a). Eine Bienendressur auf Wasser [A training of bees to water]. *Zeitschrift für vergleichende Physiologie*, 21, 463-467.
- Hertz, M. (1935b). Die Untersuchungen über den Formensinn der Honigbiene [The experiments on the sense of form in honeybees]. *Die Naturwissenschaften*, 23, 618-624.
- Hertz, M. (1935c). Rezension: Koehler, Otto: Das Ganzheitsproblem in der Biologie [Review of Otto Koehler's work: The problem of totality in biology]. *Schriften der Königsberger Gelehrten-Gesellschaft, Naturwiss. Kl. 6/7*. Halle/Saale: Niemeyer 1933. *Die Naturwissenschaften*, 23, 376.
- Hertz, M. (1935d). Zur Physiologie des Formen- und Bewegungssehens. II. Auflösungsvermögen des Bienenauges und optomotorische Reaktion [Concerning the physiology of vision of form and movement. II. Resolving power of the bee eye and

- the optomotor reaction]. *Zeitschrift für vergleichende Physiologie*, 21, 579-603.
- Hertz, M. (1935e). Zur Physiologie des Formen- und Bewegungssehens. III. Figurale Unterscheidung und reziproke Dressuren bei der Biene. [Concerning the physiology of vision of form and movement. III. Pattern differences and reciprocal training in the bee]. *Zeitschrift für vergleichende Physiologie*, 21, 604-615.
- Hertz, M. (1937a). Beitrag zum Farben- und Formsinn der Biene [Contribution to the study of color and form sensitivity in the bee]. *Zeitschrift für vergleichende Physiologie*, 24, 413-421.
- Hertz, M. (1937b). Die Beziehungen von Instinkt und Intelligenz im Tierreich [The relation between instinct and intelligence in the animal kingdom]. *Journal de Psychologie Normale et Pathologique*, 34, 324-341.
- Hertz, M. (1937c). Versuche über das Farbensystem der Biene [Experiments on the color system of bees]. *Die Naturwissenschaften*, 25, 492-493.
- Hertz, M. (1938). Zur Technik und Methode der Bienenversuche mit Farbpapieren und Glasfiltern [On the technique and method of the bee experiments with colored paper and glass filters]. *Zeitschrift für vergleichende Physiologie*, 25, 239-250.
- Hertz, M. (1939). New experiments on color vision in bees. *The British Journal of Experimental Biology*, 16, 1-8.
- Hertz, M., & Imms, A. D. (1937). On the responses of the African migratory locust to different types of background. *Proceedings of the Royal Society of London – Series B – Biological Sciences*, 122, 281-297.

Author Note

The authors would like to thank Viktor Sarris for constructive comments on an earlier draft of this article. Correspondence concerning this article should be addressed to Dr. R. Kressley-Mba at the Institute of Psychology, J. W. Goethe-University Frankfurt am Main, Georg-Voigt-Str. 8, 60054 Frankfurt am Main, Germany, E-Mail: Kressley-Mba@psych.uni-frankfurt.de.

This article may not exactly replicate the final version published in the EPF journal. It is not the copy of record. For the corresponding publication in the APA journal *History of Psychology* please check the following link: <http://www.apa.org/journals/hop.html>.

Footnotes

¹ Information cited as Anonymous (1992) was extracted from a text found in the local history collection of the Central Cambridge Public Library. There is no record of authorship or source. John Hurst (personal communication to S. Jaeger, July 2001) claims that the essay was handed down to someone at Cambridge University and eventually to someone in the library at the occasion of a dedication of a monument on the grave of Mathilde Hertz's mother, Elisabeth Hertz neé Doll, on October 7, 1992. Hurst believes that the essay was originally written in German sometime between 1984 and 1992 and has painstakingly retyped parts of the text.

² Recently Lorenz's work, including his comments on the relation between natural science and idealistic philosophy as well as an analysis of holism with regard to animals and perceptual phenomena, has been translated by Robert D. Martin (1996).

Figure Captions

Figure 1. This is a photograph of Mathilde Hertz in her personal identity card dated 1924. Copyright 1996 by Siegfried Jaeger. Reprinted with permission.

Figure 2. Examples of visual stimuli used in experiments with bees. The double columns denoted respectively by a, b, or c refer to categories of forms with differently perceived “figural qualities.” The “figural intensity” increases from the bottom of the columns upwards. Figures reprinted from “*Über figurale Intensitäten und Qualitäten in der optischen Wahrnehmung der Biene*” [Concerning figural intensities and qualities in the optical perception of bees] by M. Hertz, 1933, *Biologisches Zentralblatt*, 53, pp. 22-23.

Figure 3. Examples of visual stimuli varying in depth perception (i.e., convex, concave, flat, and mixed). Reprinted from “*Die Organisation des optischen Feldes bei der Biene. III*” [The organization of the optic field in the bee. III.] by M. Hertz, 1931, *Zeitschrift für vergleichende Physiologie*, 14, p. 634.

Ehefrau



Lichtbild

Unterschrift des Paßinhabers

Mathilde Hertz

und seiner Ehefrau

Es wird hiermit bescheinigt, daß der Inhaber die durch das obenstehende Lichtbild dargestellte Person ist und die darunter befindliche Unterschrift eigenhändig vollzogen hat.

München, den 9. Sep. 1924

POLIZEIDIREKTION
Passabteilung





