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Carlo Brentari

Jakob von Uexküll

The Discovery of the Umwelt between Biosemiotics and Theoretical Biology

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The Discovery of the Umwelt between Biosemiotics and Theoretical Biology

Springer

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Foreword

I was first introduced to the work of Jakob von Uexküll when I was a doctoral student at the Karl-Franzens-Universität of Graz (Austria). The PhD thesis that I was writing, and that would later become a book (Brentari 2007), was dedicated to the philosophical anthropology of the American philosopher Susanne Langer (1895–1985), a student of Cassirer and Whitehead and a good connoisseur of the German philosophical anthropology. I was studying the second volume of Langer's *Mind. An Essay on Human Feeling*, when I came across a report, certainly partial and not at all systematic, of Uexküll's conception of the Umwelt. In the mentioned work, Langer tries to reconstruct the steps that led from what she sees as the animal organization, based on largely immediate reactions to perceptual stimuli, to a human world made of persistent and complex symbolic representations. In doing so, Langer focuses mainly on Uexküll's description of lower animals, and tends to neglect the many common areas that the Estonian biologist noted between the environments of higher animals and that of human beings. Her aim was to highlight the specificity of man, in line with the belief in the qualitative difference between the animal *Umwelt* and human world (*Welt*) that, in the twentieth century, characterized so much of the German philosophical anthropology and philosophy.

After finishing my PhD thesis, I started with the direct reading of Uexküll's texts – first in an occasional way, then with the clear intent to write something about him. Uexküll's writings told another story: not only the relationship between man and animals appeared to be a gradual one, rather than a sudden jump, but (what is more important) the approach of Uexküll appeared more focused on the *meaning* of the different species' environments, than on the respective performances of "man" and "animals". The acknowledgment of the Kantian roots of Uexküll's thought – i.e. of his aim to extend the transcendental approach from human reason to each animal subjectivity – made it possible for me to analyse the different species-specific Umwelten as products of the autonomous constitutive power of a living subject, be it human or animal. At the same time, I would not have fully understood the Uexküllian conception if, besides Kant's influence, I had not paid attention to the semiotic component of the Umwelt: the organisms' ability to create, use and

modify signs and meanings, both in the "interior" constitution of the species-specific environment, and in the everyday life in it. Among the interpreters who made me aware of the need to consider even this aspect I must mention Sebeok and Merleau-Ponty.

At the present point of my confrontation with Uexküll's work, I see the relationship that the animal carries out with its Umwelt as a complex system of biosemiotic interactions; at the same time, I regard animal behaviour not as a set of reactions, however complex, but as the result of the spontaneous attribution of meaning to the outside world, whose environmental elements are actively interpreted by the subject according to the rules of its species. Thanks to Uexküll, the environment of animal species has revealed itself as a field of meaning, that on the one side is rooted in the physiology of the species, but on the other allows the animal subject a high plasticity of action. This perspective can strongly lessen the distance between animals and men, crediting both firstly with the transcendental ability to constitute the conditions of their own experience, and secondly with the semiotic skill to grasp meanings and to use signs. I hope I have succeeded not only in highlighting these aspects of the thought of Uexküll, but also in transmitting the sense of wonder and profound respect that he felt in front of living beings and of their capacity to enrich the meaning of what surrounds them and us.

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Reference

Brentari, C. (2007). *La nascita della coscienza simbolica. L'antropologia filosofica di Susanne Langer*. Trento: Editrice Università degli Studi di Trento.

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I would like to express my deep gratitude to Marcello Barbieri for his encouragement in realizing this book and for the interdisciplinary suggestions that he gave (and gives) to my scientific activity.

My grateful thanks are also extended to Morten Tønnessen for his rich introduction to the book, to Guido Cusinato, who helped me understand some aspects of the relationship between Uexküll and the German philosophical anthropology, and to Ferdinand Fellmann, Francesco Ghia, Romano Màdera, Ferdinando Marcolungo, Andreas Oberprantacher, Giorgio Vallortigara and Nestore Pirillo for their constant support and encouragement throughout the years of my philosophical research; a special thanks to Silvano Zucal for having said, many years ago: "Why don't you write something about Uexküll?". Finally, I wish to thank all those who have worked at the editing of the book (in its Italian or English edition): Sara Bignotti, Ilario Bertoletti, Fabio Berardini, the translator Catriona Graciet, Catherine Cotton, and Ineke Ravesloot; without their patience and passion, all that would not have been possible.

Contents

Chapter 1
Introduction: The Relevance of Uexküll's Umwelt Theory Today

Morten Tønnessen

Abstract This introductory chapter has three main purposes. The first is to present the book *The Discovery of the Umwelt*, emphasizing its specificity in the context of the international publications dedicated to Uexküll. The second aim is to describe the reception of Uexküll in Norwegian ecophilosophy, and particularly by Peter Wessel Zapffe (1899–1990) and Arne Næss (1913–2009). The third aim is to outline a possible strategy for updating Uexküll's Umwelt conception in a zoosemiotic and ecosemiotic direction. The strategy is based on the idea of comparative mapping of the subjective environments, in order to have a deeper insight of the coding und decoding processes by which different animal species constitute their Umwelt.

Keywords Ecophilosophy • Zoosemiotics • Ecosemiotics • Comparative Umwelt mapping

Not counting Uexküll's own works, Carlo Brentari's book *The Discovery of the Umwelt: Jakob von Uexküll Between Biosemiotics and Theoretical Biology* is in a sense the first English-language, scientific introductory monograph on Uexküll's Umwelt theory.[1] Several dissertations have been written on Uexküll's work, and in 2007 the historian Florian Mildenberger published the first scientific biography

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Portions of this chapter are based on three papers presented at conferences. These are: "We the living: The reception of Uexküll in Norwegian eco-philosophy" (10th International Gathering in Biosemiotics, Braga, Portugal, June 22–27 2010), "In the gaze of the other: Describing cultural affordances by conducting comparative Umwelt mapping in animal studies" (Biosemiotics and the Study of Culture, pre-conference seminar July 16th 2012 ahead of the 12th International Gathering in Biosemiotics, Tartu, Estonia, July 17–21 2012) and "Codes and interpretation in perception" (First International Conference in Code Biology, Paris, France, May 20–24 2014).

[1] I say "in a sense" because, for one thing, the genre of Brentari's book is multifaceted. Though it is absolutely *about* Uexküll's Umwelt theory, rather than about Uexküll as a person, it also features biographical and historical elements, as reflected in its systematic presentation and discussion of Uexküll's main works in chronological order. Furthermore, it is definitively scientific, but not in all senses "introductory", given its wide scope and advanced argumentation.

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about Uexküll, *Umwelt als Vision: Leben und Werk Jakob von Uexkülls (1864–1944)* (Mildenberger 2007). Brentari's monograph is based on a translation of his 2011 Italian monograph *Jakob von Uexküll. Alle origini dell'antropologia filosofica* [Jakob von Uexküll: At the origins of philosophical anthropology] (Brentari 2011).

In his book, Brentari starts out with a biographical overview in Chap. 2. His periodization of Uexküll's scientific publications (cf. *3.2 Periodization of Uexküll's Production*) forms the basis for much of the remaining structure of this volume. According to Brentari, Uexküll's texts can fruitfully be divided into three periods based on his principal interests and topics. The time frames for these three periods are 1892–1909, 1910–1918 and 1919–1944. Brentari writes that the respective periods are characterized by a first development of a research method and dissemination of results of empirical research (early period), a combination of empirical research and theoretical reflection (intermediate period), and theoretical works (late period).

The first period is covered in Chap. 3 ("The Basis of the Environmental theory"), the second in Chap. 4 ("The Subjective World of the Umwelt") and the third period in Chap. 5 ("The Structure of the Umwelt") and Chap. 6 ("Environment and Meaning"). The concluding Chap. 7, in turn, treats Uexküll's influence on a number of philosophers and other scholars – namely (in this exact order) Max Scheler, Helmuth Plessner, Arnold Gehlen, Ernst Cassirer, Susanne Langer, Martin Heidegger, Ferdinand Ebner, Jacques Lacan, Georges Canguilhem, Maurice Merleau-Ponty, Gilles Deleuze and Felix Guattari, Konrad Lorenz, and finally Thomas Sebeok and contemporary semiotics.

Throughout the text, Brentari combines a biographically and historically informed description of Uexküll's developing ideas and views with occasional evaluation and criticism. Brentari's own views are particularly transparent in the Conclusion section at the end of the book, but increasingly so in the book's last chapters also. *The Discovery of the Umwelt* is thus a book where many voices are heard: Uexküll's voice first and foremost, then secondarily the voices of those he criticized or influenced, and finally the voices of his critics (a group which overlaps considerably with the group of people Uexküll inspired). As Brentari succinctly states in the Conclusion, we need, in our time, a "modification of the concept of Uexküllian Umwelt [which] respects the deepest spirit of the author."

"In order to grasp "Why biosemiotics?"", Magnus and Kull (2009: 125) claim, "one needs to comprehend Uexküll." That is no exaggeration. It is doubtful whether biosemiotics would have emerged at all, had it not been for Uexküll's Umwelt theory. In this perspective, it is quite natural that several biosemioticians are at the forefront of the loose network that in effect represents "Uexküll's modern heirs". Biosemiotics has been central in the contemporary revival of interest in Uexküll's work, which as Brentari outlines followed a period of declining interest in Germany and elsewhere. "The absence of a mental heir, on a par with Uexküll's own rank (except for his son Thure perhaps), who would carry on and expand *Umweltlehre*", Magnus and Kull (ibid., 123) observe, "seemed to lead to the death-blow of Uexküll's research in the two decades following Uexküll's death." This understanding is nuanced, but broadly speaking confirmed, by Brentari, at least as far as biology is concerned.

Brentari's focus in his investigation of Uexküll's influence on academic thought and worldviews is predominantly on philosophers. This makes sense given Uexküll's application of philosophical thought, and the explicit and implicit philosophical claims that constitute central parts of his biological theory. It also makes sense given the extraordinary influence Uexküll has had on central philosophers including Ernst Cassirer, Martin Heidegger, Maurice Merleau-Ponty and Gilles Deleuze. As a philosopher himself, Brentari has extensive knowledge of philosophy, and is very capable of tracing the links to classical philosophers such as Aristotle, Plato and Kant. In particular, Brentari is a capacity on the work of Jakob von Uexküll, philosopher Susanne Langer, and ethologist Konrad Lorenz, the latter of whom Uexküll knew personally. Fortunately, Brentari is also more skilled in the history and philosophy of biology than most other philosophers who dare to say something about biological matters.

In the remainder of this introductory chapter, I will refer to selected aspects of Uexküll's life and work, present the reception of Uexküll in Norwegian eco-philosophy,[2] and assess the need for modernising the Umwelt theory. The section "Updating the Umwelt theory" is followed by two related, more focused sections, entitled "Codes and interpretation in perception" and "Describing cultural affordances by conducting comparative Umwelt mapping" respectively. The first of these connects biosemiotics with code biology, the second aims to make connections between biosemiotics on one hand and Human–Animal Studies and human ecology on the other. In both cases the Umwelt theory, in a modernised version, is proposed as a unifying theoretical framework.

1.1 Life and Work

As is well known, Jakob von Uexküll was neither a philosopher nor a semiotician – and yet his work has had inspirational influence within both philosophy and semiotics, and continues to have this effect today as well, in both areas of inquiry. In stating that "there are as many worlds as there are subjects and [...] these worlds are phenomenal worlds", von Uexküll (1928: 61, cited in *5.3.1 Signs in the Environment: the Transcendental Biosemiotics of Uexküll*) is in effect establishing an alternative ontology informed by biology. In *4.2 The Gegenwelt*, Brentari points out that "one of the most fascinating aspects of the Uexküllian idea of the environment [is] that between the subject (human or animal) and the external reality there is a semiotic relationship, of *interpretation* or even *translation*". As Brentari argues, while *Streifzüge durch die Umwelten von Tieren und Menschen* (von Uexküll and Kriszat 1934[3]) has been the most successful book by Uexküll in terms of readers

[2]This subchapter is intended as a supplement to Brentari's broader portrayal of Uexküll's influence.

[3]Cf. also von Uexküll 1956 [1934/1940] and the most recent translation to English, von Uexküll 2010.

and translations, *Bedeutungslehre* [Theory of Meaning] (von Uexküll 1940) has been less influential generally, but has a central position for semioticians given its detailed semiotic outlook.

A look at the bibliography of Jakob von Uexküll (see *References*, Chaps. 3–6) is quite telling. Between 1892, the year Uexküll turned 28, and his death in 1844, Uexküll published extensively, usually with several publications each year. But he published no text in 1898, 1906 (the year after he and Gudrun had settled in Heidelberg, where Uexküll had worked as a research assistant in 1888 and 1901–1902) and 1911. In the years 1911–1914, as Brentari describes in *2.2 Research Trips and Contributions to Physiology*, Uexküll carried out research trips in private capacity after having raised funds for this purpose. This is reflected in Uexküll publishing eight articles in 1912 and five or six in 1913. But then Uexküll published only one or two texts in 1914, and only one in each of the years 1915, 1916, 1917 and 1918. The maximum page count for publications appearing in the years 1914–1918 is only 75 pages. Of course, the years 1914–1918 coincided with World War I, and that is part of the explanation of the low productivity these years, given the impact war may have on society at large. Furthermore, as the bibliography shows and as Brentari explains in *2.3 Arising of Political and Philosophical Interests and the Transition to Theoretical Biology*, during WWI Uexküll was unable to perform experiments, so he devoted himself instead to taking his theoretical concepts in new directions, particularly a political one.[4]

Brentari explains Uexküll's turn to more theoretical works in his late period, 1919–1944, in part with the First World War's economic consequences for the Uexküll family.[5] After the war, due to the changes it had brought with it, Baron Jakob von Uexküll lost his nobility, and his whole family lost its land and its assets. Uexküll would to some extent be able to return to experimental work after the establishment in 1927 of *Institut für Umweltforschung*,[6] a fact which is reflected in examples provided in *Streifzüge durch die Umwelten von Tieren und Menschen* (von Uexküll and Kriszat 1934).

The first few years after WWI stand out in sharp contrast to the mediocre productivity of the war years, with the publication of among other texts *Biologische Briefe an eine Dame* (published as a book in 1920, cf. von Uexküll 1920a) and the first edition of *Theoretische Biologie* (von Uexküll 1920b), followed by the second edition of *Umwelt und Innenwelt der Tiere* (von Uexküll 1921). Uexküll now returns to publishing several texts each year. Even though he formally retired in 1936, this goes on until 1938, the year that Uexküll turns 74, upon which he publishes only one text in 1939. *Bedeutungslehre* (von Uexküll 1940), his last major theoretical work, is published in 1940 along with two other publications, but in 1941 Uexküll publishes

[4]Generally Uexküll's political texts have little value for our own time's ethical discourse, cf. Beever and Tønnessen 2013.

[5]Cf. *3.2 Periodization of Uexküll's Production.*

[6]See *2.4 The Institut für Umweltforschung in Hamburg*.

nothing, in 1942 only a Spanish translation appears – and the same occurs in 1944, the year Uexküll dies. His last text published while he was still alive was "Darwins Verschulden!" [Darwin's fault!] in 1943 (von Uexküll 1943). By then Uexküll and his wife Gudrun had (in 1940) moved to Capri, Italy, where he would die in July 1944.[7]

1.2 The Reception of Uexküll in Norwegian Eco-philosophy

Peter Wessel Zapffe (1899–1990) and Arne Næss (1913–2009) are two of the foundational figures of Norwegian eco-philosophy (cf. Reed and Rothenberg (eds) 1993). Eco-philosophy is here to be understood as the philosophy of ecology, or more broadly an ecologically inspired philosophical outlook. As a variety of philosophy, eco-philosophy can according to the third classical Norwegian eco-philosopher, Sigmund Kvaløy Setreng (1934–2014), be conceived of as being both descriptive and normative (cf. Kvaløy Setreng 1974, 2004).[8] This conception is employed in the following. Both Næss and Kvaløy Setreng acknowledged Zapffe's pioneering work in addressing conservation issues, already in the twenties and thirties. In terms of chronology he was the first Norwegian eco-philosopher.

Næss, generally regarded as the founder of deep ecology (Næss 1989), has been influential internationally in the context of environmental philosophy and ethics.[9] Uexküll's Umwelt theory plays a central role in the doctoral dissertations of both Zapffe (1996 [1941])[10] and Næss (1936), both of which were published shortly after they were written and defended. In the case of Næss, it must be pointed out from the outset that he did not, to my knowledge, refer to Uexküll in the context of deep ecology, which he developed from the early seventies onwards.[11] But even though Uexküll, for Næss, mattered first of all in the development of his early, pre-environmentalist philosophy, these connections are arguably of general interest. It remains a fact that Uexküll, the pioneer of ethology, informed the early work of

[7] See *2.5 Frictions with the Nazi Regime and Death*. The island of Capri was occupied by the US from late 1943 onwards.

[8] Næss distinguished between 'eco-philosophy' as a descriptive discipline and 'ecosophy' (ecological wisdom) as a normative discipline. Zapffe's preferred term for his eco-philosophy was 'biosophy' (meaning something akin to "wisdom of life", and implying an empirical approach informed by biology to the problems of life and to the human condition). In line with his normative orientation, Kvaløy Setreng furthermore frequently referred to 'eco-politics'.

[9] Cf. "Umwelt ethics" (Tønnessen 2003), which is an attempt to combine the deep ecological platform (Næss 1993: 197) with Umwelt theory. Specifically, this article conveys an Uexküllian interpretation of the deep ecological platform.

[10] The thesis includes an English language summary pp. 619–622.

[11] Neither is Uexküll referred to in *Wisdom in the Open Air: The Norwegian Roots of Deep Ecology* (Reed and Rothenberg (eds) 1993). Few scholars involved in deep ecology appear to be significantly engaged by the work of Uexküll, or aware of Næss' early use of the Umwelt theory.

Næss, who would later become a pioneer of modern eco-philosophy. Uexküll's placement in Zapffe's work is more central, since in his case Uexküll's Umwelt theory constitutes a central ingredient, or premise, in his main work, namely the doctoral dissertation *Om det tragiske*. For Næss, the Umwelt theory was more of a passing interest.

Zapffe and Næss were friends and to some extent colleagues. A passion they had in common was mountaineering, i.e. climbing mountains, and what is in Norwegian called "friluftsliv" (literally: life in the open air), i.e. walking and spending time outdoors, in nature. Their personalities were very different, with Næss being known for his stated optimism on behalf of the twenty-first century, and Zapffe known as a notorious philosophical pessimist (though his writings also involve occasional comedy). In his doctoral thesis, Zapffe actually goes as far as to claim that humankind should voluntarily stop reproducing – this, he states, is the only real solution to all "world problems" (cf. also Zapffe 1993 [1933]).

Despite the fact that Zapffe was some 14 years older than Næss, Næss was early at a more advanced career level than his older friend and fellow climber. He defended his doctoral thesis at the age of 23, and was appointed professor of philosophy at University of Oslo at the age of 27. As a young man, Næss had taken part in discussions with members of the so-called Vienna circle. When Zapffe defended his doctoral thesis in 1941, Næss was the third member of the committee evaluating his dissertation – and with a decisive vote, as it would turn out, since the other two members of the committee disagreed on whether or not to approve it.

Both authors treat and apply Uexküll's Umwelt theory with a view to its implications for humans, or the human perspective. In Zapffe's dissertation, Uexküll is the tenth most cited author (measured by number of page references in the index). He is less cited than playwrights Ibsen and Shakespeare, and Goethe, but almost as much cited as Aristotle and more cited than Kant, Hegel and Nietzsche. In Næss' dissertation, Uexküll is among the five most cited authors (by the same measure), along with Bertrand Russell and ahead of central figures such as Rudolf Carnap (1891–1970), Ernst Mach (1838–1916) and Henri Poincaré (1854–1912). Psychologist Edward C. Tolman (1886–1959) and physicist Percy Williams Bridgman (1882–1961) are among the few that are more cited.[12]

At the time and for the next 30 years or so, Næss was inspired by the positivist idea of unitary science.[13] The aim of his thesis *Erkenntnis und wissenschaftliches Verhalten* [Knowledge and scientific behaviour] was to offer an "objective-psychological" description of scientific behavior. Some say that Næss in this work placed the natural scientist in the position of the lab rat, and

[12]In the Preface (Vorwort), Næss acknowledges his debt to pragmatists and the Vienna circle, noting that they are not much referred to, despite the fact that they had been the most influential forces for the dissertation. In the dissertation, Charles Sanders Peirce (1839–1914) is referred to once, and William James (1842–1910) and John Dewey (1859–1952) are also referred to.

[13]Later on, in Næss 1972, he would instead favour pluralism and possibilism, which in effect implies acknowledging that radically different theories can be complementary and legitimate.

not everybody was found of the idea. Næss refers to the Umwelt theory as objective-psychologically oriented (Næss 1936: 244) and thus in line with his own preference. In Næss' understanding, the objective-psychological description of scientific behaviour is according to Uexküll's Umwelt theory a part of the "special biology" ("der 'speziellen Biologie'") of humans (ibid., 68).

The texts by Uexküll he makes use of is the second edition of *Umwelt und Innenwelt der Tiere* (von Uexküll 1921) and *Theoretische Biologie* (possibly the second edition, Uexküll 1928, though exact information on edition and publication year is not provided). Næss claims that his description of scientific behaviour is "Umweltforschung" in Uexküll's sense – "it concerns the particular Umwelt of scientists" (ibid.).[14] Early on in the thesis, Næss launches a thought experiment (ibid., 9).

> A scientist from another solar system comes to our planet in order to investigate its moveable parts – that is, us. The stranger will not be a specimen of *Homo sapiens*, and will further not master the language and the philosophical culture of humans. The only characteristic it has in common with us is its ability to observe certain events/incidents. *How would the stranger describe what we call 'objects and content of knowledge'?*

This thought experiment, Næss states (ibid., 10), "enables us to establish a programmatic thesis about the objective-psychological describability of physical objects and content of knowledge: *The alien scientist can wholly describe physics solely by way of observation of* [...] *the functional cycles of physicists."* Here, Næss' use of the Umwelt theory resembles Uexküll's own use of it in the final pages of *Streifzüge durch die Umwelten von Tieren und Menschen* (von Uexküll and Kriszat 1934).

Uexküll is mentioned sporadically throughout the text, and a full section, §19 (pp. 64–70), entitled "Die Lehre von der Umwelt eines Tieres" [The theory of the Umwelt of an animal], is devoted to his work. The section falls within the dissertation's second chapter, on existing inquiry of intersubjective and objective-psychological description of objects and content of knowledge. Næss criticises "die Labyrinterkenntnistheorie" [the epistemological theory of the labyrinth], which he associates with behaviourist Karl Spencer Lashley (1890–1958)[15] and physicist and mathematician James Hopwood Jeans (1877–1946),[16] for randomly identifying the *Umgebung* (physical environment) of the human observer with the situation of the observed organism (ibid., 58). The scientist does thus not acknowledge, or realise, that there is a fundamental difference between the Umgebung of the observer and the Umwelt of the observed animal.

Næss' point is recognisably Uexküllian, but it is not entirely clear whether his exact use of the notion of 'Umgebung' is consistently in line with Uexküll's. Most importantly, to the extent that e.g. a lab scientist and a rat are located in

[14]Translation here and in the following by M.T.

[15]Næss (ibid., 53) refers to Lashley 1923.

[16]Næss (ibid., 54) refers to Jeans 1934.

the same place, the Umgebung could be said to be the same for them. Given Uexküll's perspective it would therefore have been more precise to state that the epistemological theory of the labyrinth erroneously confuses the scientist's *Umwelt* with the rat's Umwelt – or, that this theory confuses the rat's Umgebung (as perceived by the human observer) with the rat's Umwelt.

In Zapffe's dissertation *Om det tragiske* [On the tragic], Uexküll plays the role as *the* biologist, depicting the worlds of the living and establishing the radical difference between the living and the non-living. This extensive text (more than 600 pages) is simultaneously a work of literary criticism, particularly on the genre of the tragedy, and an existentialist treatise aiming to throw "a significant light on the human condition here on Earth" (pp. 620–621).[17] The Uexküllian works Zapffe refers to are *Bausteine zu einer biologischen Weltanschauung* (von Uexküll 1913), and – as in Næss' case – the second edition of *Umwelt und Innenwelt der Tiere* (von Uexküll 1921). Unlike Næss, Zapffe mentions examples of animals having senses humans do not have, or sensing in ranges we do not.

From Uexküll's Umwelt theory, Zapffe learns that there is a fundamental difference between the biotic and the abiotic world. Based among other things on Uexküll's treatment of protoplasm, Zapffe observes that there is a "brotherhood of suffering" extending from the amoebae to the dictator (Zapffe 1996 [1941]: 15–16). Read in context this does not imply any claim that all living organisms are sentient, but rather a claim that all living beings are subjected to living conditions which may be, or in some respects are, unjust. The ever-present possibility of dying, and the fear this omnipresent possibility gives rise to is portrayed as the worst horror of all – especially for the self-conscious humans, whose whole existence can be formed, moulded and ultimately ripped apart under such anxious influences.

Zapffe defines the 'tragic process' in general in terms of "three characteristics: a culturally relevant greatness, or magnitude, in the afflicted individual, a catastrophe that befalls him, and a functional relation between the greatness and the catastrophe" (ibid., 620). Asking whether there is a "wholly necessary tragic", he then concludes that the human kind is a tragic species, because it is mentally (or cognitively, as we might say today) over-equipped. While other animals live in relative harmony, experiencing an overall balance between abilities and needs – here Zapffe builds explicitly on Uexküll's Umwelt theory – humans represent an exceptional species, an exception to the rule. Our behaviour is characterised by radical flexibility, cf. e.g. the fact that the human hand is not a specialised limb. However, we have needs that cannot be satisfied. Zapffe depicts four 'interest fronts', or concerns: The biological, the social, the autotelic and the metaphysical. To varying extent, animals too have a share in the three first interest fronts, and these areas of life humans can happily indulge in. But a human demands more than just this. We expect and demand a meaningful, just world order – but this metaphysical need is in Zapffe's view

[17] On a private note, it was while reading *Om det tragiske* during my master studies in philosophy that I first came across Uexküll's work. This discovery in effect brought me to Tartu and to biosemiotics. Translation here and in the following by M.T.

destined for disappointment at best or some kind of denial at worst. The environment is either indifferent to us, or even worse – at times 'satanic' – since the world is not organised according to human principles.

1.3 Updating the Umwelt Theory

As Brentari describes, Uexküll's intellectual development involved moving from the view that "[e]very animal is nothing but an ordered bunch of reflexes" (von Uexküll 1905: 10, in translation), and from using the term 'milieu', to adopt and gradually refine the notion of 'Umwelt' in a direction that in most cases minimises the role played by reflexes (one of seven action types according to Uexküll). Generally speaking, Uexküll's later works are more mature and developed than his earlier works. Some theoretical problems, however, accompany his Umwelt theory no matter what stage of Uexküll's intellectual development we are looking into.

Before we look into the major problems with the Umwelt theory, however, I would like to make clear that there are many more or less hidden nuances in Uexküll's work. Many of these are concisely treated by Brentari. *The Discovery of the Umwelt* thus shows how Uexküll in effect distinguishes between centered and decentered Umwelten (cf. Uexküll's notion of reflex republics), and between the isolated qualities or properties perceived by lower animals and the unitary, cohesive Umwelt objects of higher animals (the problems of object synthesis and object stability). Furthermore, Brentari communicates Uexküll's view that acquisition of new schemata may occur, and his understanding of the plasticity of human perception and action, how symbolic language enlarges human experience, and what distinguishes the species-specific human role as *the observer*. As Brentari rightly states in *5.2 The Human Observer's Environment*, "in its maximum breadth the environment [Umwelt] of man coincides with the world as it is seen by science." Uexküll's nuances are supplemented by Brentari's systematic distinction throughout the book between *perception* (what is perceived) and *reperception* (what is perceived in the sense of coming to awareness).[18]

There are at least four significant problems theoretically with the Umwelt theory as developed by Uexküll: (1) What Brentari calls his Kantian problem, (2) Uexküll's idea of perfect harmony in the relation between organism and environment, (3) the Umwelt theory's relation to animal psychology, and (4) Uexküll's political use of the Umwelt theory.

The Kantian problem is a problem for anyone who is not a Kantian (of Uexküll's inclination). Brentari emphasises that the root of the problem is related to Uexküll's insistence that there are aspects of nature, or in fact aspects of any existing thing or being, that are unknowable (the Kantian *thing-in-itself*). He furthermore argues that

[18]One reason why this distinction is important is that animals do not necessarily reperceive (i.e., are not necessarily aware of) their own actions.

Uexküll's Kantian sympathies and perspectives brings him into trouble whenever he attempts to solve explanatory problems by appealing to uninvestigable rules and plans of nature which are postulated but hard to evaluate – since that in effect contradicts his empirical research program. As if this was not enough, Uexküll's Kantian conviction leads him to portray Umwelten as closed, sealed-off worlds. This said, it is also evident in Uexküll's work that he explicitly explains how he departs from Kant's understanding.[19] Also, as Brentari claims in the Conclusion's *8.3 Limits and Prospects of the Uexküllian Environmental Theory*, Uexküll's "tendency to think of living species and their ecology in terms of animal-environment systems [. . .] allows him to go beyond Kant, by turning the transcendental subject into an interpreting subject, and by turning environmental experience into a translating and interpreting process."

As with the Kantian problem, Uexküll's idea of perfect, pre-established harmony in the relation between organism and environment is well presented and analysed by Brentari too. In *6.2.2 Individual Recognition and "Companions" in Social Birds* he stresses that in Uexküll's work "dysfunction often appears as an enigma", and that he "tends to silently pass over the potential for misunderstanding or error in the relationship between animals and environment". This is a significant weakness, which must be overcome. Though Uexküll eventually accepted that new species emerge, his version of the Umwelt theory cannot fully explain e.g. extinction whether as normal or as exceptional (as in the era of the Anthropocene). As Brentari says in the *Conclusion*, "nothing stops us from imagining, if we expand the scope of the Uexküllian concepts, a natural evolution of the animal-environment systems, or even a natural evolution of the environments [Umwelten]". This presupposes admitting "contingency in the formation and modification of environments [Umwelten]". Brentari correctly observes that acknowledging this implies admitting the possibility of imperfection and extinction.

In my own work I have referred to *Umwelt transitions* (see Tønnessen 2009) as a key concept for an updated Umwelt theory capable of addressing issues of environmental change, whether normal or exceptional. An Umwelt transition is defined as a lasting, systematic change, within the life cycle of a being, considered from an ontogenetic (individual), phylogenetic (population-, species-) or cultural perspective, from one typical appearance of its Umwelt to another (ibid., 49). An understanding akin to that in line with the notion of Umwelt transition is in my opinion essential for really acknowledging the spontaneous organizing power of the organism, and for acknowledging animals as autonomous entities.

[19] See particularly Uexküll 1928: 3, also cited in *5.3.1 Signs in the Environment: the Transcendental Biosemiotics of Uexküll*: "The task of biology is to expand the outcome of Kant's research in two directions: i. to take into account the role of our body too, in particular of our sense organs and central nervous system, and ii. to investigate the relationships with the objects of the other subjects (animals)". Under i. Uexküll establishes the body as the subject several years before Merleau-Ponty did something similar; under ii. he implicitly establishes an *Uexküllian phenomenology* (cf. Tønnessen 2011a).

This understanding is consistent with the view – which has support in Uexküll's own texts – that intraspecific variability is the norm, not the exception. Critique of the idea that Umwelten are necessarily species-specific will be referred to in the subchapter *Describing cultural affordances by conducting comparative Umwelt mapping*. In my opinion one has to understand that in Uexküll's work, Umwelten are typically presented as species-specific *as a shorthand* to understand other organisms. The purpose of speaking of Umwelten as species-specific is not to make any claim that all Umwelten are species-specific, but rather to present perspectives on Umwelten that are easily applicable and generally meaningful. In other words, Uexküll's portrayal of Umwelten as species-specific should be understood as a pragmatic move, not as an essential one.

The third major theoretical shortcoming, the Umwelt theory's relation to animal psychology ('Tierpsychologie') in Uexküll's depiction, must of course be understood in light of the history of biology and the state of animal psychology at Uexküll's time. Uexküll's renunciation of the ideas of animal psychology was motivated by his resistance to using anthropomorphic concepts. As a result, he ended up going too far in ascertaining that he made no claim about animal minds. Brentari's language in this impressive work is telling of the difficulty associated with avoiding notions such as "awareness" and "perception" – for Brentari himself uses both of them (and rightfully so!), and Uexküll used several comparable concepts. As I state in Tønnessen 2009 (ibid., 61), it is evident that Uexküll in his work in fact does assume the existence of experienced worlds. And in a modern biosemiotic perspective, concepts such as 'perception' and 'action' would be rendered meaningless absent of the assertion that the reconstructed Umwelten of biology and other fields of inquiry aims to be models of experienced worlds which are themselves subjective, private models of the semantically loaded landscape that surrounds Umwelt creatures.

The fourth and last major theoretical shortcoming, Uexküll's political use of the Umwelt theory, is not immanent in his biological theory as such, but instead related to his own interpretation and more-than-biological application of it. Brentari's treatment of Uexküll's socio-political texts is rather short (se particularly *2.3 Arising of Political and Philosophical Interests and the Transition to Theoretical Biology*), but he does point out that the biologist's political take on his biological theory lead him, for one thing, to oppose democracy. This was, as Brentari explains, motivated by his refusal to give the individual priority over the social environment. Anyone who is inspired by the Umwelt theory and has an interest in developing some kind of biological worldview – or a biosemiotic ethics – should take note of Uexküll's occasionally reprehensible usage of his biological theory in a political context (cf. Beever and Tønnessen 2013). As seen from our time, Uexküll also entertained a now outdated view on gender differences.

Overcoming the abovementioned theoretical shortcomings by developing Umwelt theory further should be combined with expanding Uexküll's Umwelt theory on areas where there is greater potential for applying it, or for developing it theoretically. More work should be done on human Umwelten. Here, the tripartite Umwelt model, presented in the subchapter *Codes and interpretation in perception*,

is meant as one contribution with particular (though far from exclusive) relevance for the human realm. In short, Umwelt mapping and the like only makes sense if the 'ethograms' of Umwelt theory are detailed enough to be applicable in different contexts, including the human context. The concluding subchapter, *Describing cultural affordances by conducting comparative Umwelt mapping*, is similarly meant as a contribution to developing the zoosemiotic (here human–animal) and ecosemiotic (here human–environment) study of natural relations. In the *Conclusion*, Brentari aptly states that Uexküll's work (and, implicitly, an updated Umwelt theory) can be of great use in conservation biology, because it shows us how preserving biodiversity implies protecting "the semiotic, perceptive and operative worlds in which life unfolds."

1.4 Codes and Interpretation in Perception

As Marcello Barbieri pointed out during the opening address of the First International Conference in Code Biology,[20] we must not commit the mistake of claiming that *everything* is codes, nor the mistake of claiming that *everything* is interpretation. Therefore, the task of outlining the complementarity of coding and interpretation is crucial. In this subchapter I present work in progress on the role of interpretation vs. coding in perception. My notion of perception rests on the assumption that perception can most often but not always be understood in terms of coherent (i.e. unified) subjective experience. I follow Jakob von Uexküll (1956 [1940], cf. 2010) in assuming that all organisms except plants and fungi have Umwelt experience, and that most animals have coherent, unified subjective experience rather than decentered Umwelt experience.[21]

My starting point is the *tripartite Umwelt model* (Tønnessen 2011a), according to which any Umwelt has two aspects (*core* and *mediated*) and some have three (including a *conceptual* aspect). I theorise that these three layers interact dynamically so that one or two of the layers are occasionally temporarily suspended (in other words, perception is subsequently focused – more or less exclusively – on different Umwelt layers). By *core Umwelt*, I mean the aspect of Umwelt within which one interacts directly and immediately with other creatures or Umwelt objects, in (to use a figure of speech) "face-to-face" encounters.[22] By *mediated Umwelt*, I mean the aspect of Umwelt in which Umwelt objects are encountered

[20] Paris, May 20–24 2014.

[21] Plant and fungi are endowed with phenomenal worlds of a more diffuse kind – Uexküll called them 'Wohnhüllen'.

[22] However, in all normal instances, i.e. whenever the perceiver e.g. is capable of having memories or at least is capable of anticipating events, our actual encounters with others involves mediation, and thus the mediated Umwelt, as well. Only in exceptional cases, in consequence, are actual "face-to-face" encounters located *solely* within the core Umwelt.

indirectly by way of some mediation (memory, fantasy, anticipation, modern media, etc.). I suggest that this particular aspect of Umwelt can generally be associated with Uexküll's notion of the *Suchbild*, the *search image* (cf. von Uexküll 2010: 113–118). By *conceptual Umwelt*, I mean the aspect of Umwelt in which one navigates among Umwelt objects in terms of predicative reasoning in general or human language in particular.

In Tønnessen forthcoming, I outline the workings of the Umwelt in terms of these three aspects in more detail. We can generally conceive of six types, or categories, of acts, and these can be located within the three different aspects of the Umwelt:

Core Umwelt

- Automated acts of perception
- Automated mental acts

Mediated Umwelt

- Wilful acts of perception
- Wilful mental acts

Conceptual Umwelt

- Habitual acts of perception
- Habitual mental acts

By *automated*, I mean the exact and physiologically based matching of something with something else. By *wilful* I mean the agenda- and interest-driven matching of something with something else. By *habitual* I mean the learned matching of something with something else. Whereas conscious animals carry out all six types of acts, non-conscious creatures, in so far as they perceive, only carry out two, namely automated and wilful acts of perception. Habitual, i.e. conceptual acts, are reserved for conscious creatures, but even bacteria can carry out wilful acts of perception, i.e. make choices based on interpretation.

Above I have defined the conceptual Umwelt as the aspect of Umwelt in which one navigates among Umwelt objects in terms of predicative reasoning. By predicative reasoning, I mean the habitual, mental act of ascribing a specific feature to someone or something. Animals that ascribe specific features to other living beings or objects via mental acts are arguably capable of carrying out a fundamental form of logical reasoning. An animal's capacity for predicative reasoning can be more or less advanced and complex. As we see, we can define the conceptual Umwelt as related to any kind of reasoning.

In general terms automated acts as understood here can be said to be code-based, whereas both wilful and habitual acts are interpretation-based. An implication of this claim is that the core Umwelt is generally code-based, and that the mediated Umwelt and the conceptual Umwelt are interpretation-based. If this is correct, then the interpretive threshold is not located where animals *with* a nervous system meet creatures *without* a nervous system (as Marcello Barbieri has claimed), nor where the biotic meets the abiotic (as Jesper Hoffmeyer (2008) and several others have

claimed). Instead, *the interpretive threshold must be located where core experience meets mediated experience* – and since these aspects often intermingle, the dividing line is not in plain sight.[23]

While I have only begun reflecting on the notion of code itself, I will in the following relate codes in perception as presented here to the notions of *neural* codes and *ecological* codes. First, however, a distinction between two fundamentally different sorts of codes is required.

CODE$_{fix}$ (fixed code): A code which after at some point being fixated remains practically unchanged
CODE$_{flex}$ (flexible code): A code which remains in flux

A retrospective observation is now called for: When I above claimed that in general terms automated acts (whether perceptual or mental) can be said to be code-based, and that the core Umwelt is generally code-based, I had CODE$_{fix}$ (fixed code) in mind. Generally speaking, neural codes can be conceived of as instances of CODE$_{fix}$. In Barbieri's words (2014b),

> [t]he transformation of the signals received by the sense organs into mental images, or high-level neural states, is based on sets of rules that are often referred to as neural codes, because neurobiology has made it abundantly clear that there are no necessary connections between sensory inputs and mental, or neural, images.

Barbieri (ibid.) claims that fishes and some other animals "have virtually hardwired reactions, and in those cases animal behavior is indeed largely accounted for by neural codes only." Nicolelis and Ribeiro (2006: 77) report that

> [a]lthough the neural code is far from cracked, we are able to catch, and to speak, a few syllables now, and that was not true just 10 years ago. One important reason that we can already use this idiom is its inherent adaptability, which in turn stems from the network properties of communication through neural ensembles. Even if a few words are dropped, the message still comes across, much the way a robust technological network can rapidly compensate for the loss of a few nodes.

The use of a fixed code, in other words, is not necessarily inflexible as regards its processing – the final outcome is what matters.[24] A second retrospective observation is called for: In general terms automated acts can be said to be code-based, *or more specifically based on neural codes*. I thus theorise that there are two kinds of automated (i.e. code-based in the sense of CODE$_{fix}$) acts which are in sum

[23]To what extent this claim is consistent with Marcello Barbieri's view that "neural semiosis is based on coding and interpretation" (Barbieri 2014a) is open to discussion. Questions for further investigation include whether and to what extent coding in automated acts of perception, and in automated mental acts, can be understood within the current framework of code biology (Barbieri et al. 2014).

[24]Cf. Swan and Goldberg 2010, who in an analysis of Nicolelis' research define "brain-objects" as "the neurobiological intermediary between sensory stimuli and consequent behaviour".

Table 1.1 Umwelt codes

Type of codes	Corresponding aspects of Umwelt	Involved codes
$CODE_{fix}$	Core Umwelt	Neural codes + non-neural codes?
$CODE_{flex}$	Mediated Umwelt	Ecological codes
	Conceptual Umwelt	(including cultural codes)

constitutive of the core Umwelt – automated acts of perception, and automated mental acts.[25]

Ecological codes can, according to Farina (2014), "be defined as mechanisms that establish an arbitrary set of connections between two or more components (organisms and/or their aggregations) of a complex system." As we shall see, ecological codes are to be regarded as instances of $CODE_{flex}$, flexible codes. Kull (2010: 354) defines an ecological code "as the sets of (sign) relations (regular irreducible correspondences) characteristic to an entire ecosystem, including the interspecific relations in particular." In a somewhat similar manner, Maran (2012: 149) states that it "is plausible to assume that codes on the ecological level are not strict regulations, but rather ambiguous and fuzzy linkages based on analogies and correspondences." In Maran's outlook (ibid., 150),

> [e]cological codes are distributed and open [. . .] *no single individual or species has full perception of an ecological code*. Instead, an ecological code forms as the sum of memories and experiences of corresponding perceptions. Every single species and organism involved in an ecological code has a partial variation of the convention.

In conclusion, Table 1.1 indicates that there are various *Umwelt codes*, related to all three aspects of the Umwelt, and that Umwelt codes are typically fixed in the core aspect of Umwelt, and flexible in the mediated and conceptual aspect, respectively, of the Umwelt. Since several Umwelt creatures are not conscious, it makes sense theoretically to predict or postulate the existence of non-neural, fixed codes at work in the core aspect of the Umwelt of non-conscious organisms.

1.5 Describing Cultural Affordances by Conducting Comparative Umwelt Mapping

In this ultimate subchapter, I conclude my treatment of the need for updating, or modernising, of the Umwelt theory of Jakob von Uexküll. The associated field of study is here Animal Studies understood as any scientific study of animal behaviour (including ethology and studies conducted within Human–Animal Studies, also called anthrozoology).[26] In this context, my objective is not to point out theoretical

[25] Whereof the latter is applicable to conscious animals only.

[26] In semiotic parlance, this subchapter is particularly relevant for zoosemiotics and ecosemiotics.

shortcomings of Uexküll's Umwelt theory, but rather to suggest new lines of investigation in terms of how Umwelt theory may be applied. The premise is that *Umwelt mapping* can be conducted much more widely than it has been so far. The procedure for Uexküllian Umwelt mapping is in simplified terms "(a) to identify significant others and (b) to determine the functional tones of their relations to the Umwelt being at hand" (Tønnessen 2010a: 388, see also Tønnessen 2011b). The methodology of Umwelt mapping can be relevant for fields including ethology, anthropology, and cultural studies.

Describing human culture is often taken to imply delimiting "the human". However, as Lestel (2002: 55) claims, "every human society is characterized by the nature of the hybrid communities its members establish with animals, which takes into account the animals involved and the structure of the relations established." Lestel underlines that such hybrid human-animal communities are above all "semiotic communities" (ibid.). This fact raises the question of how the artefacts and other manifestations of human culture are perceived by animals, and how studies of animal perception of human cultural processes and artefacts can be informative for our understanding of human culture. What is a human – to an animal? And what is an anthropogenic artefact or physical structure to an animal?[27]

As Uexküll was well aware, animals never perceive humans *as* humans, in the *human* sense of human. "Anything and everything that comes under the spell of an environment [Umwelt] is either redirected and re-formed until it becomes a useful carrier of meaning or it is completely neglected" (von Uexküll 2010: 144, cf. von Uexküll 1940: 109). The tick, for instance, perceives the human (as well as any other mammal) as a generic mammal.

The standard perspective on Umwelt objects (i.e., objects in an Umwelt) implies that the Umwelt is a set (or whole) of species-specific Umwelt objects. Our current perspective, however, implies that one and the same (physical) object can be regarded as an Umwelt object in the Umwelten of different animals. For example, humans appear as various kinds of Umwelt objects in the Umwelten of various animals, and anthropogenic artefacts and constructions likewise appear as Umwelt objects in various ways in different Umwelten. Here, comparative Umwelt mapping motivates us to ask: What functional tones do the relevant objects have in their relations to other animals (from the perspective of these other animals themselves)? And how do they compare? Particularly, what are their affordances (i.e. potential meaning for anyone capable of perceiving them)? And, finally, in what ways are the wide-ranging affordances that these objects of culture have informative of human culture?

Possible case studies include humans (their whereabouts, appearances and movements), human waste, garbage, sewage, anthropogenic noise and light etc., affiliated species (their whereabouts, appearances and movements), buildings,

[27]By implication, what is here called "cultural artefact" might include any product of our affiliated species, such as livestock (for the notions of 'affiliated species' and 'global species', cf. Tønnessen 2010b).

vehicles (made use of in urban/rural/wildlife areas), roads and railway tracks etc., fences, technological devices (radio-collars, helicopters etc.) used in wildlife management, grids, dams, and plantations.

Focusing on artefacts and constructions rather than humans themselves, the material can be organised in terms of four major categories, enveloping human products as perceived by non-humans

1. in urban and household settings
2. in agriculture
3. in wildlife settings
4. in "the shadows of human civilisation" (think of rats thriving in our sewage systems, etc.)

These categories may overlap somewhat. In combination they represent the way our culture qua human products appears in the Umwelten of non-humans – in the gaze of the other, so to speak.

The Umwelt theory of Jakob von Uexküll is well known in biosemiotic circles, but not many have taken to develop Umwelt methodology as foundational for comparative studies. Umwelt theory can, as argued in this subchapter, be applied to describe the manifold affordances of human constructions, artefacts etc. from a non-human point of view. As already alluded to, whenever Umwelten are discussed, the focus tends to be on each particular, "species-specific" Umwelt.[28] The human Umwelt is thereby characterised by being fundamentally different from any animal's Umwelt. But in the age of the Anthropocene – the global era of anthropogenic development – countless animals and other creatures regularly encounter human constructions, artefacts and waste (indeed, numerous lifeforms have adapted to such occurrences). For this reason the following question is of great *empirical* interest: How do the products of human civilization manifest themselves in the Umwelten of other creatures?

A simplified procedure for conducting Umwelt mapping has been presented above. This builds on Uexküll's methodology as described in detail by himself.

> We are faced with the following: There is an alien/unfamiliar subject – an animal – which we can observe in our own Umwelt. We know that this Umwelt gets its genuine character from ourselves. We can never get to know the character that the alien/unfamiliar subject gives to its own Umwelt. The only task that is feasible for us consists in this: Through observation of and experiment with each part of our own Umwelt [we can] confirm which ones are present also in the alien/unfamiliar Umwelt. (von Uexküll 1910: 128)[29]

[28]For a critique of this understanding, see *1.1. Appraisal of Sebeok's depiction of the Umwelt as species-specific modelling system* in Tønnessen 2011a: 19–20.

[29]Translation by M.T. Original: "Wir befinden uns folgender Sachlage gegenüber. Es ist uns ein fremdes Subjekt – ein Tier – gegeben, das wir in unserer Umwelt beobachten können. Wir wissen, daß diese Umwelt ihr eigentümliches Gepräge durch uns selbst erhält. Das Gepräge, das das fremde Subjekt seiner Umwelt gibt, können wir niemals kennen lernen. Die einzige Aufgabe, die für uns lösbar ist, besteht darin: durch Beobachtung und Experiment jene Teile unserer Umwelt herauszufinden, welche in die fremde eingreifen."

The Rock Dove, also known as the Rock Pigeon (*Columba livia*) can serve as an example. The species includes both the domestic pigeon and feral pigeons. The Rock Dove is arguably a global species in the sense of Tønnessen 2010b, and has been widely introduced in different parts of the world. Having a long history of relations with humans, Rock Dove populations are especially common in cities and towns. In the wild, cliffs, particularly sea cliffs, are typical features of the habitat of the Rock Dove. While domesticated Rock Doves live in captive environments, feral Rock Doves typically seek building features resembling sea cliffs. This redirectioning or re-forming of the Rock Dove's urban perceptive material in line with the Rock Dove's natural habitat, which has a bearing e.g. on establishment of nesting sites, is a clue to understanding the Umwelt of feral Rock Doves. Besides being prey for raptor species, the Rock Dove is in several places a game species for humans too, at the same time as feral Rock Doves are fed by humans in many towns and cities, and/or being persecuted as a pest species. Their specific relations to humans therefore exhibit significant variability.

I will conclude this final subchapter by presenting a few cautionary remarks. Since perception occurs at very different scales of time and space, and in the context of varying sensory capabilities and ranges, a crucial question for any Umwelt researcher is this one: Is Umwelt object X (in our human Umwelt, Umwelt A) actually perceived *as an object* by Umwelt creature B? For instance, is our threatening posture, our persona, our edible flesh an Umwelt object to Umwelt creature B? In terms of categorical perception, we can further ask whether a specific Umwelt object X (in the human Umwelt, Umwelt A) is (1) similarly categorised by Umwelt creature B, or (2) differently categorised, or (3) not at all categorised (i.e. not at all an Umwelt object for Umwelt creature B).

Of particular interest, perhaps, is the fact that several anthropogenic objects and constructions certainly appear as Umwelt objects in the Umwelten of several non-humans, but not in human Umwelten.[30] That is a characteristic of the Anthropocene. Relatedly, we may justifiably ask whether our collective human *Wirkwelt* (operative world) is today consistently bigger than our collective human *Merkwelt* (perceptive world), to the effect that the *Merkwelten* of other animals (and hence, to some extent, their *Wirkwelten* too) are substantially affected by our actions without us even knowing it?

As we see, comparative Umwelt mapping at the edges of culture, aimed at describing cultural objects as these are perceived by non-human eyes, can enrich our understanding of the (largely anthropogenically affected) 'near abroad' of the human ontological niche,[31] or human semiosphere. The human realm is not neatly distinguished from the non-human, instead, the human and the non-human interlink.

[30]Particularly, certain abandoned cultural products may serve as medium for other lifeforms: e.g. ship wrecks and abandoned oil platforms which may come to serve as artificial reefs.

[31]The term 'ontological niche' is introduced in Tønnessen 2003: 288.

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Chapter 2
The Life and Education of Jakob von Uexküll

Abstract The chapter presents the main events of Jakob von Uexküll's life (1864–1944): the childhood in the estate of Keblaste, the school years in Coburg, the university years in Tartu, the study and research trips to Italy and France, the economic and professional difficulties due to World War II and the Russian Revolution, the creation of the *Institut für Umweltforschung* in Heidelberg, the frictions with the Nazi Regime, the decision to move (for health reasons) to Italy, where Uexküll died in 1944. Along with the biographical events, the chapter introduces some reference points that will be important to understand the Uexküllian concept of Umwelt: the Kantian transcendental approach, the influence of vitalism, the relations with the emerging discipline of ethology.

Keywords Uexküll's biography • Estonia • Germany • *Institut für Umweltforschung* • Frictions with Nazi Regime • Biology • Vitalism • Ethology

2.1 The First Studies in Philosophy and Science

The biologist Jakob von Uexküll belonged to a family of the ancient German Baltic nobility.[1] The origins of his family go back to the first arrivals of German knights in the Baltic lands. His name derives from the Estonian term "uex", one, and "külla",

[1]The main sources of information on the life of Jakob von Uexküll are the biography published in 1964 by his wife, Gudrun von Schwerin-Uexküll (von Uexküll 1964), and the work by Florian (Mildenberger 2007). While Gudrun von Uexküll's biography is very precise both about his institutional scientific career, and about Uexküll's personal and social life, Mildenberger's work, more accurate and scientific, is a detailed reconstruction of the theoretical and historical institutional context in which Uexküll worked. For a good summary in English on the other hand, see Rüting 2004; the article refers to both the sources mentioned. As regards an overall assessment of the theoretical aspects of Uexküll's work, introductory monographs are not available so far, except for special issues dedicated to Uexküll of the magazines "Semiotica" and "Sign Systems Studies" (whose interpretation is, however, specifically semiotic, with the risk of neglecting other aspects of the Uexküllian work), *cf.* "Semiotica" 134 (2001), "Sign Systems Studies" XXXII, 1/2 (2004).

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village, and therefore means "a village". Uexküll's ancestors were granted the title of baron as a reward for their loyalty as vassals, and from then on the history of the family – which the oldest records describe as violent, quarrelsome and always ready to rise above the law – is inseparably linked with that of Estonia.

One of Jakob's ancestors, Berend Johann von Uexküll, is remembered for having issued, the year of the French Revolution, a private "law" which granted freedom to the peasants who tended his lands and for being in favour of the liberation of all Estonian farmers (who were subjected to serfdom like throughout the Tsarist empire). In 1811, on the initiative of the Baltic nobility, the Russian government passed a law which freed Estonian farmer. Fifty years later, the "Liberating Tsar" Alexander II extended this measure to the whole kingdom. Few years after these reforms, Jakob's grandfather, Bernhard Otto, was critical of the nobility's policy towards peasants and tried to accelerate the ongoing modernization process (Mildenberger 2007: 16). Bearing this in mind, Jakob always felt inwardly bound to continue this liberal tradition. Far from thinking himself in some way superior to others because he belonged to a noble family with a century-old history, he was always convinced that the value of an individual derives solely from his actions. Along with other reasons, it was this conviction that brought him, as we will see, to oppose Nazism's ideological use of the concepts of "blood" and "race".

Jakob von Uexküll was born on September 8th 1864 on the family's small estate at Keblaste, now Mikhli. He was the third of four children, two older brothers and a younger sister. His father, Alexander, was a territorial administrator for the Russian government and nourished a strong passion for natural sciences, especially geology. His mother, Sophie von Hahn, has been described as an intelligent and sociable woman with a great sense of humour. The estate of Keblaste, situated in a still intact rural environment, offered Jakob a wide variety of experiences in nature. From a very early age he spent many hours intent on observing beetles, caterpillars and frogs. As the children grew older, the family began to spend most of the year in the baronial house of Reval (now Tallinn), where the boys were able to attend the Episcopal school.

In spring 1875, his older brother Alexander fell seriously ill, so the family moved to Coburg in Germany, where Alexander could receive better medical care. The time in Coburg, during which Jakob attended the local *Gymnasium*, lasted about 3 years. After returning to Estonia, Jakob completed high school and in 1884 he enrolled at the Faculty of Natural Sciences at the University of Dorpat, now Tartu, and chose zoology as his main discipline. His years at university were decisive for his intellectual development. During *Gymnasium* Jakob had already read Kant's *Critique of Pure Reason*, from which he drew strong intellectual stimulation. Under the influence of Kant, at this stage nature appeared to him in the first place as a set of phenomena rigidly determined by antecedent causes, and from which is therefore absent any teleology. According to Mildenberger, this mechanistic interpretation of Kant – which ignores the *Critique of the Power of Judgment* and the ideas that it will offer to the Romantics' philosophies of nature – is due to the influence of

biologists such as Mayer[2] and Helmholtz,[3] who from 1842 turned to Kant to oppose the prevailing vitalistic theories. But a similar interpretation of Kantianism is also found in a scientist like Gustav Magnus.[4]

Thus, in his early university years, Uexküll's worldview is that of a "convinced determinist and materialist" (von Uexküll 1964: 24), but even before that, at a lecture in preparation for his confirmation, he is said to have expressed the opinion that "every action takes place according to a law of nature" and that "the statement "I am the author of my actions" is a self-complacent nonsense" (von Uexküll 1964: 24).

The study of Kant also led Jakob to define, extremely early, what his main interest as a biologist would be: understanding the cognitive modalities that shape animal species' perceived environment. In other words, Jakob's interest for species-specific "subjective worlds" may be born as an in-depth study of the Kantian thesis according to which the experience of living beings is determined by *a priori* categories. He realized that the transcendental analysis that Kant directed to the minds of human beings could be extended to other animal species too. This way, the study of the transcendental structures of the mind left the field of pure logic to enter that of natural sciences (i.e. what we would call cognitive sciences today). In Uexküll, the exploration of pure reason becomes the pursuit of ways to access the cognitive worlds of nonhuman animals. Transcendental philosophy thus emerged as a new scientific discipline, both empirical and theoretical, which Uexküll called *Umweltlehre* (theory of the environment).

If it is expected for his theoretical interests to become dominant in Uexküll's work, they coexist with a very strong inclination towards direct observation as well as anatomical and physiological study of animals. Already during his first year of university he set off for the Dalmatian island of Lesina (now Hvar) with Alexander Braun – his zoology teacher, who held a vitalist position. There he had the occasion to study marine fauna directly, which remained the main destination of his empirical research.

[2]Robert Mayer (1814–1878) was a German physician and physicist who studied the phenomena of the body's metabolism focusing on the assumption of conservation of energy within physiological processes. From the point of view of theoretical biology, he pursued the aim of replacing the vitalist notions of the time (in particular the so-called "vital force" of plants) with empirically demonstrable and quantitatively measurable forces.

[3]Hermann von Helmholtz (1821–1894) was a German doctor, physicist and physiologist, he was the pupil of Johannes Müller (cf. *below*, 24, n. 6) and Gustav Magnus (cf. *below*, n. 4). He played a role in the turning point of the 1840s, when physiology was separated from metaphysics and put into the category of natural science aimed at achieving empirically demonstrable and mathematically quantifiable results. After some work of a purely physiological, he volunteered an application of the physics of forces to the body metabolism, in particular to the muscle system.

[4]Gustav Magnus (1802–1870). German physicist and chemist, he was among the founders of the *Berliner Physikalische Gesellschaft*. Characterized by a purely empirical position, he rejected any form of idealist philosophy of nature. His studies include the physics of gas and heat transmission.

In the 4 years he attended the University of Dorpat, Uexküll came into contact with the second of the theories – this time in opposition – which would determine his vision of the world: the Darwinian theory of evolution by natural selection. As far as the reception of Darwinism is concerned, the cultural environment of Dorpat was mainly affected by the influence of the vitalist biologist von Baer,[5] who was very well known in Germany and in the rest of Europe. In addition to his studies on the reproductive systems of mammals and marine animals, von Baer was known for his fierce anti-Darwinism. According to von Baer, the weakness of the Darwinian theory of evolution consists in its being focused solely on antecedent mechanical causes and on random variations, and that it actually ignores the teleological character of every organic process (ultimately due to a superordinate and external factor to nature itself). Against Darwin von Baer raises Johannes Müller's theses,[6] perhaps the last vitalist to have left his mark on German medicine. Müller's work is also very important for Uexküll to shape his biological and environmental conception. On the one hand it represents a connection with Schelling and Hegel's romantic philosophies of nature (Cimino 1997: 14; Lohff 1997: 141); on the other hand, however, it underlines the importance of experiment even for the vitalist scientist.[7]

The prestige and influence of von Baer, which was not only considerable within the academic world but also among the Baltic Germans in general, meant that (at least until his death) the University of Dorpat remained a stronghold of anti-Darwinism and vitalist biology. This outcome was also due to the great power of the Evangelical Theological Faculty of Dorpat, which systematically opposed teaching evolutionist theses. A significant example is the case of Schleiden[8]: in 1864, he

[5]Karl Ernst von Baer (1792–1876) was an Estonian biologist and anthropologist, professionally active in Germany and Russia. He studied medicine at Dorpat, Berlin and Vienna. In the early years of his career as a researcher (Königsberg 1819–1834), Baer focused mainly on embryology, succeeding in isolating the egg in the ovaries of female mammals in 1926. From the point of view of biological theory, the importance of Baer lies on the one hand in the fact that he proposed a unified theory of animal procreation (the egg as original cell in all animal species), and on the other hand that he peremptorily underlined the epigenetic character of embryonic formation: it proceeds from the homogeneous to the heterogeneous, and it is not sustainable that the parts of the animal are already preformed in the egg (von Baer 1827).

[6]Johannes Müller (1801–1858) was a German physiologist and zoologist, from 1830 he taught anatomy and physiology at the University of Berlin. In addition to scientific knowledge and a great inclination for empirical research, Müller has a solid philosophical background (he was a student of the theologian Christian Brandes, who introduced him to Aristotelian philosophy). In the course of his work he devised a philosophy of nature that combines elements of Goethe's colour theory with romantic idealistic notions. Besides Helmholtz (*cf. above*, 23, n. 3), Ernst Haeckel (*cf. below*, 51, n. 6) also appeared among his pupils.

[7]In the family library, Uexküll also had access to the transcript of the lecture on nature held by Hegel in Berlin in 1821–1822, which was written by his grandfather, Berend-Johann von Uexküll (1793–1870), known as Boris von Uexküll (Mildenberger 2007: 38; Hegel 2002).

[8]Matthias Schleiden (1804–1882) was a biologist, botanist and anthropologist. Along with Theodor Schwann (1810–1882), he was the founder of the modern cell theory, which he developed from the

had to leave the Chair of Plant Physiology and Anthropology because of pressures from the members of the Evangelical Theological Faculty. A strong supporter of an inductive and materialistic biology, Schleiden made it no secret that he considered the vitalist concepts (such as life force) as an obstacle to the progress of biology based on an empirical approach (Mildenberger 2007: 30).

During Uexküll's years there, the situation within the Faculty of Natural Sciences of Dorpat improved slightly for the supporters of Darwinism and materialism, as the appointment of a scholar like Kraepelin[9] demonstrated. Among the courses in Uexküll's syllabus was also included the one on the theory of evolution held by Professor Julius von Kennel (1854–1939), a staunch Darwinist. Uexküll described the encounter with Kennel as follows:

> While until that moment I had been dealing with the analysis of solid facts, Kennel's influence made me consider theory for the first time. Kennel was a professed Darwinist and a supporter of the theory of descent. Initially I was very impressed by the network of relationships that Darwin had established between animal configurations. The simple concepts of modification and survival of the adapted seemed to provide a plausible explanation of the origin of species. [...] But Kennel himself completely ruined that impression when he assured he was able to prove the relationship between two given species taken randomly out of all the existing ones. I thought to myself quite rightly: "These are only games, not science" (von Uexküll 1964: 35–36, 38).

The initial enthusiasm with which Uexküll accepted Darwin's theory, consistent with the materialism and determinism he professed, quickly changed into a definitive and radical rejection of the very idea of natural selection.[10] This rejection – which brought Uexküll to formulate alternative theories in the following years, which could explain the differences and similarities between biological species without the use of Darwinian theoretical tools – in the short term directed his choice to engage in empirical research rather than in the formulation of general theories.

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work of the English botanist Robert Brown (1773–1858). Schleiden devoted the last part of his activity to anthropological and historical-cultural research.

[9]Emil Kraepelin (1856–1926) was a German physician and psychiatrist. In 1882 he was working in Wilhelm Wundt's (1832–1920) laboratory of experimental psychology. His studies mainly focus on *dementia praecox* and manic-depressive psychoses, and his approach is empirical with somatic-materialist tendencies (which often results in a lot of attention to the pharmacological aspects of the studied diseases).

[10]The research conducted by Mildenberger on the copy of *The Descent of Man* owned and read by Uexküll also highlighted that the latter tended to reduce the well-structured Darwinian theses to the sole struggle for existence, and that he was not interested in other parts of the theory of evolution (such as sexual selection). Greater interest can be found regarding topics such as perception and social behaviour of animals though (Mildenberger 2007: 37–38). In the following years, in particular in the article *Darwin und die englische Moral*, to the criticism regarding the biological field Uexküll added the heavy accusation that British imperialism could find in Darwinism, and particularly in the supremacy of the strong, a sort of ethical and political justification (von Uexküll 1917: 229).

2.2 Research Trips and Contributions to Physiology

The new direction his research took is also due to Uexküll's decision to abandon his zoology studies in order to devote himself to physiology, in which he graduated in 1890 with a thesis on the parietal organ in the frog. Incubated in Dorpat, this decision was reached in the following years: first in 1888, then in the years 1901–1902 Uexküll worked in Heidelberg as an assistant to the physiologist Wilhelm Kühne[11] at the *Physiologischer Institut* of the local university. His field of investigation concerned neuro-muscular physiology. In this period Uexküll's research practice attempted to reconcile mechanistic hypotheses with vitalist theoretical thesis, following that synthetic approach that would characterize all his later works (Mildenberger 2007: 53–54).

During his long collaboration with the University of Heidelberg, Uexküll regularly went to the Zoological Station in Naples, a scientific institution founded in 1873 by Anton Dohrn[12] and financially supported by the German government and the city of Naples. The Zoological Station, which welcomed marine biologists from all theoretical backgrounds, was one of the most important meeting points for the different lines of research that Europe could boast in those years. Its openness also made it possible for scholars who found themselves in strong theoretical opposition to meet. Amongst the most significant of these meetings, we should mention the one which took place between 1880 and 1890 and involved the famous biologist Driesch[13] (who explicitly defined himself as "neovitalist" from 1898) and the mechanist Loeb,[14] founder of the theory of tropisms.

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[11]Wilhelm Kühne (1837–1900) was a German chemist and physiologist; he was a pupil of Helmholtz and mainly dealt with muscle physiology. But his studies in cytology also led him to take a stand in the debate on cell structure and on the function of cell protoplasm, two topics that were of great interest to Uexküll (see *below*, 65).

[12]Anton Dohrn (1840–1909) was a German zoologist who adhered to Darwinism through the influence of Haekel (they were very close friends in their youth) and devoted himself to the reconstruction of the evolutionary history of animals, particularly marine life. For this purpose, he founded a research station on marine biology in Naples in 1870, the Zoological Station, which soon became a meeting point for physiologists and biologists of international importance. Over the years, Dohrn became increasingly involved in the organization and financing of the Zoological Station, and dedicated himself to empirical research to a lesser extent.

[13]Hans Driesch (1867–1941) was a German biologist and philosopher. In his youth he studied with Haekel and adhered to his mechanistic and Darwinian view of phylogeny and of evolution. The works of Wilhelm Roux (*cf. below*, 30, n. 23) on frog eggs led him to seek an answer to one of the empirical questions that, at the time, divided biologists into two opposing sides (mechanists and vitalists) that of the nature of the process of embryonic formation. Between 1891 and 1900, at the Zoological Stations of Trieste and Naples, Driesch repeated Roux's experiments on a sea urchin egg (for details *cf. below*, 53). Unlike Roux, the results of his experiments led him to stand firmly in favour of a vitalist theory which would focus on the effective action of an extramaterial organizing principle (the entelechy) on the embryo and in general on the organic matter.

[14]Jacques Loeb (1859–1924) was a Jewish German biologist and physiologist, considered one of the leading exponents of mechanism in the late nineteenth century. Strongly influenced by

Uexküll arrived in Naples in April 1891 to pursue his studies on marine fauna; his intent was to extend to marine fauna (especially octopus and sea urchins) the methods of investigation developed by Kühne for frogs. At the Zoological Station Uexküll had the occasion to become acquainted with Driesch and to gain a thorough understanding of the experiments the latter used to demonstrate the inadequacy of the mechanistic theses mainly in embryology. It was at that time that Uexküll began to form the idea of total finality that characterizes living organisms. This "correspondence with a plan" (as the German word *Planmäßigkeit* could be literally translated) is particularly visible in the motor system of the sea urchin.

As Uexküll's friend and pupil Otto Cohnheim[15] recalled,

> his experiments [on sea urchins] impressed us very much, but above all we were struck by the first appearance of what Uexküll called "construction plan" [*Bauplan*] and explained as follows: "When a dog runs, it moves its legs – when a sea urchin runs, it is moved by its legs. The sea urchin is a republic of reflexes [*eine Reflex-Republik*], where the central nervous system is replaced by the construction plan" (von Uexküll 1964: 41)

At the same time, however, as Mildenberger commented, in his work as a physiologist, Uexküll was still "completely taken by the possibilities of mechanistic thinking" (Mildenberger 2007: 57), so much so that he saw the nerve connections of the animals he examined as "automatic machines" (von Uexküll 1894: 593) connected by a comprehensive system of reflexes. This coexistence of a mechanistically oriented research practice and a teleological-vitalist philosophy of life was a characteristic of the Uexküllian approach.

In 1899, the biologist went to Paris to study in the laboratory of the physiologist Etienne Marey,[16] famous for being among the first scientists to apply cinematographic techniques to the study of animals' body movements (the *chronophotographic* method, as it was then called). Uexküll learned the new technique, successfully used it on the movements of fish and butterflies and then introduced it to the Naples Zoological Station (Rüting 2004: 39). At the same time, together

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Schopenhauer's philosophy, Loeb tried to investigate the existence of will in living organisms from an empirical point of view. His field of study looked into tropisms, i.e. fixed motor reactions in response to certain stimuli. Extending the research of Julius von Sachs, who had demonstrated the existence of tropisms in the vegetal world, Loeb wanted to show that physiology and animal behaviour can also be interpreted in terms of fixed reactions to given stimuli. Loeb was at the Naples Zoological Station between 1889 and 1890.

[15]Otto Cohnheim (1873–1953) was a German chemist and physiologist who was famous for his research on enzymes, respiration and the effects of ultraviolet rays. In 1913 he became the director of the Physiology Institute of the Eppendorf Hospital in Hamburg. In 1917 he changed his name to Kestner to conceal his Jewish origins. Cohnheim met Uexküll in Naples in 1893, and then he did not hesitate to appeal to his academic contacts to help Uexküll. Their friendship continued until the death of Uexküll.

[16]Etienne Jules Marey (1830–1904) was a French physiologist who became famous for the invention of graphic and cinematographic recording techniques of physiological or motor processes. From a theoretical point of view, Marey supported a form of reductionist mechanism, based on the assumption that the processes taking place in living beings should be reducted to physical and chemical laws (Marey 1873).

with his colleagues Behte[17] and Beer,[18] Uexküll wrote an article in which they criticized the anthropomorphic terminology used in physiology at the time and they suggested replacing it with an "objectifying terminology" (Uexküll et al. 1899: 517). The article, which became quite well-known and was positively received by the behaviourists in the U.S. and by Pavlov[19] in Russia, suggested for example to replace the term "sight" and "smell" respectively with "photoreception" and "stiboreception" (Harrington 1996: 42; Rüting 2004: 40).

In 1900, following Kühne's death, Uexküll's situation at the *Physiologischer Institut* in Heidelberg became uncertain. Indeed, Kühne's successor at the head of the institute, Albrecht Kossel,[20] was not interested in his research. In 1902, Uexküll was denied the access to the laboratory in Heidelberg, and in 1903 (because Dohrn turned down his request for research funds at the Zoological Station) also to the one in Naples. In the following years Uexküll was able to carry out field research only by financing his stays at various seaside resorts himself (e.g. Beaulieu, Roscoff, Berck-sur-Mer and Biarritz). The difficulty of such studies, their unsystematic nature and possibly a change in his own approach to research pushed Uexküll more and more towards theoretical reflection. The first result of this change was his essay dated 1902 *Im Kampfe um die Tierseele* [*In Battle over Animal Psyche*], where Uexküll attempted a first application of Kant's philosophy to biology (von Uexküll 1902: 24).

In 1902, in Naples, Uexküll met the 24 year-old German aristocrat, Gudrun von Schwerin, who became his wife. Ever since the beginning the couple shared the same interests, as for the rest of their lives. Gudrun, open-minded and full of scientific interests, took part in her husband's research and writing work; and when Uexküll lost his entire estate, and with it the opportunity to conduct independent scientific research, his wife helped him not only financially, but also by encouraging him to write.

At the beginning of the twentieth century, Uexküll saw his chances of getting a stable job at a research station were thin: neither the *Physiologischer Institut* or the Zoological Station of Naples, nor even the one in Rovinj (near Trieste) accepted to

[17] Albrecht Bethe (1872–1954) was a German physiologist who operated in Cologne and Frankfurt; he met Uexküll in 1897 at the Naples Zoological Station.

[18] Theodor Beer (1866–1919) was a German Jew (he converted to Christianity in his youth) and a physiologist. From 1895 Beer was one of the most regular visitors of the Zoological Station in Naples. In addition to having written the mentioned article with him, Beer evoked Uexküll's research in sensory physiology in Beer 1896: 870.

[19] Ivan Petrovich Pavlov (1849–1936) was a Russian physiologist and psychologist. Initially dedicated to the study of circulatory and digestive systems, he then moved on to neurology and behavioural science from the early years of the twentieth century. In this field, his name is inseparably linked to the reflex theory he elaborated, which is based on the distinction between conditioned and unconditioned reflexes and aspires to be globally recognised as the explanation of physiology and human and animal behaviour.

[20] Albert Kossel (1853–1927) was a German physiologist and chemist who was awarded the Nobel Prize in 1910 for his studies on the cell nucleus.

collaborate with him. This mainly depended on the fact that Uexküll was known as a theorist of biology with a vitalist and anti-Darwinian credo, as well as a staunch supporter of the applicability of the Kantian transcendental philosophy in biology; his approach to empirical research seemed to be compromised by an excess of philosophical theses. However, reality is probably more complex. Towards 1903, Uexküll began to realize that the climate of intolerance that characterized the biological debate in Germany made it impossible to follow what Mildenberger calls a "middle way" (Mildenberger 2007: 71) between vitalism (or rather – neovitalism) and mechanism, which is Uexküll's typical research pathway as we have already seen. He was so openly on the side of the neovitalists, attracting the enmity of many scientists – including Goldschmidt[21] – that he was described as somewhat of an "eccentric mystic figure" (Goldschmidt 1956: 66; Mildenberger 2007: 70, 141–142).

Although the possibility of doing research was slim, the Uexküll couple settled all the same in Heidelberg in 1905, the city where Jakob had many friends and admirers. In 1907, the University of Heidelberg awarded him an honorary doctorate of medicine. The conferment of the title, which may seem contradictory in the face of the refusals mentioned above, occurred in a very significant context, especially for understanding the peculiar esteem Uexküll was held in. As a matter of fact, the scientific motivations awarding the doctorate were the following: "For his accurate and brilliant experiments on nerve and muscle stimulation" (von Uexküll 1964: 90).[22] As Uexküll himself would discover later, this wording was purposefully chosen in order to avoid every suspicion that it was the biologist's theoretical and philosophical conceptions that were evaluated positively by the academic world.

The honorific recognition from the University of Heidelberg was followed by many others: the universities of Kiel and Utrecht awarded him an honorary doctorate and he was made a member of the Academy of Sciences in Halle. Despite these successes, Uexküll's dream of creating his own research institute seemed to be unattainable. In the years immediately before the First World War, the biologist also appealed to the *Kaiser-Wilhelm-Gesellschaft*, which did not support his project, but still granted funds for him to carry out his research in a private capacity (10,000 marks for three consecutive years). In his letter of thanks for the funds assigned to him, Uexküll expressed his regret caused by the society's rejection of his bigger project (for which the biologist estimated he needed at least 200,000 marks) and reminded them of his theoretical positions:

> If we do not want to extend the concept of biology boundlessly, but to intend it as the study of the characteristics of animals, in order to draw a clear dividing line with the science of inanimate matter, it is necessary to start from the characteristic of correspondence to a plan,

[21] Richard Goldschmidt (1878–1958) was a Jewish German Zoologist and geneticist who was active until 1936 at the Kaiser Wilhelm *Institut für Biologie* in Berlin-Dahlem, then at Berkeley University in California (due to his expatriation for racial reasons). He was best known for his studies on the emergence and transmission of mutations in the genetic makeup of organisms.

[22] In particular, Uexküll's fame in the neuromotor field was due to the discovery of the so-called *Uexküll's law*, according to which neural excitation goes through a relaxed muscle more easily than through a contracted one. The law proved useful in orthopedics (Rüting 2004: 40; Kull 2001: 5).

> which alone distinguishes the living from the inanimate. Biology thus coincides with the doctrine of the forms of conformity to a plan [*Planmäßigkeiten*] in nature [and] is divided into two main parts: in the theory of the formation of the correspondence to the plan, which its founder, Prof. Roux,[23] called "mechanics of development", and in the special biology that deals with experimentally investigating the correspondence to a plan of adult animals. I can give myself some credit in special experimental biology. [...] Whether it wants it or not, zoology must admit the existence of the living nature of the correspondence to a plan – it rejects it though in principle as a scientific problem, and under the influence of Darwinism, it tries to put in its place the obedience to mechanical laws. [...] As things stand today, biology in Germany is sentenced to death and will always be an American science (reported in von Uexküll 1964: 96).

The letter only got a formal reply. With the funds raised, between 1911 and 1914, Uexküll embarked on study trips in Beaulieu, Rapallo and Biarritz. The biologist was accompanied by an assistant (Dr. Felix Gross, a young Viennese scholar) and sometimes by his family, which greatly expanded in the meantime. Between 1904 and 1909 the Uexkülls had three children: Damajanty, the eldest daughter, the second son Thure[24] and Gustav-Adolf, their third son.

2.3 Arising of Political and Philosophical Interests and the Transition to Theoretical Biology

The outbreak of war surprised the family in Schwerinburg in Mecklenburg, on his wife's property. As a Baltic German, German culture and loyalty to the Russian monarchy were inseparably intertwined in Uexküll's family history; not to mention the fact that he had a Russian passport. Therefore, he risked being confused with the enemy. The German authorities, however, took into account his ethnic origin and his wife's status, and allowed the family to stay on. Besides, from a political point of view, the Baron was openly sided with Germany and condemned as unnatural and

[23]Wilhelm Roux (1850–1924) was an embryologist, anatomist and physiologist who was best known for having applied to intraorganic phenomena (intracellular in particular) the Darwinian concept of struggle for existence. As a theorist, Roux refused an exclusively mechanical interpretation of organic processes and gave significant weight to the holistic concept of autoregulation of the organism taken as a whole. But this did not lead him to accept neovitalist positions. In embryology he supported the thesis of the so-called mosaic embryo, i.e. of the contemporaneous presence of a number of locally situated factors ("determinants") (Roux 1881; Cheung 2004: 143–149).

[24]Carl Kuno Thure von Uexküll (1908–2004) was a doctor and psychotherapist and one of the leading figures in psychosomatic and integrated medicine in Germany in the twentieth century. Thure von Uexküll succeeded in introducing many elements from his father's *Umweltlehre* into the theory and practice of medicine, such as the holistic approach and the importance of the subject (against the objectivism of medicine). Thure studied medicine with Gustav von Bergmann (1878–1955), who had already grasped the potential of the Uexküllian theses in their understanding of the psychosomatic interactions and diseases. Of great importance are his efforts to spread the thought of his father, wherein he accentuates the semiotic aspects (*cf. below*, 225). For an introduction to the life and work of Thure von Uexküll *cf.* Otte 2001.

immoral the American alliance with Russia (of which he condemned the medieval institutions and ways, in particular as far as the Jews were concerned[25]).

Not having the chance to perform his experiments, Uexküll dedicated himself during the war years to expanding his theoretical concepts in new directions, launching a line of study that led him to publish a large number of writings on politics, morality and spirituality. This does not mean, however, that Uexküll lost touch with his main interests. For instance, when he began to deal with "vital functions" of the state, he did so by applying concepts and categories taken from his own theoretical biology to the dynamics of collective institutions. This was what happened in 1915 with the essay *Volk und Staat* [*People and state*], in which the state is seen as a natural creation of the vital power of the people, and therefore as an entity which is subjected to the latter (von Uexküll 1915: 53–66). The national character which appeared to him as the most compatible with a harmonic and organic state was the German one, which the biologist (at least in the pre-modern phase) described in idealistic tones as the bearer of a deep sense of unity and responsibility.[26]

Consistent with this vision, the original element, the "cell" of the state, is not the individual but the family. When family falls apart, the people and the state collapse too; and from this process emerges the typically modern phenomenon of mass. In mass society, both socially and politically, the organic value and the purposefulness that family and people had in common with the rest of nature are missing; and this is reflected firstly on the efficiency and resilience of democracy. "[To rule the state] it seemed to him" – his wife reminisced about that time – "that the methods of men lacked structure and planning" (von Uexküll 1964: 104).

In 1917, the Russian revolution, whose effects also affected the Baltic regions, took the baron's estates in Estonia from him (they were expropriated because of their being noble properties). Moreover, the economic crisis that accompanied the first months of the revolution made Russian State bonds, of which most of his financial assets consisted, worthless. By every possible means at his disposal Uexküll did his best to persuade the German government of the *Reich* to see to the fate of the Baltic Germans, but by the end of 1917, he had to face the facts: the separate peace of the

[25]"In Russia, thousands of Jews were tortured and burned. This is very well-known in America, and yet they carry on with their dealings by providing weapons to Russia" (reported in von Uexküll 1964: 101).

[26]The friendship and correspondence with Houston Stewart Chamberlain (1855–1927) dates back to that time. Houston Stewart Chamberlain was an English philosopher and writer who became famous for his researches on races; his works, especially *Arische Weltanschauung* and *The Foundations of the Nineteen Century,* were to be used by the Nazis to support their ideology and their racial policies (Chamberlain 1905, 1911). From the point of view of their theoretical connections, Chamberlain and Uexküll were both convinced of the superiority of German culture. Chamberlain was also inspired by Uexküll for his thesis of the centrality of the subject in natural processes (Rüting 2004: 41–42; Mildenberger 2007: 95; Chamberlain 1919: 137). The fact that Uexküll wrote the foreword to the book of Chamberlain *Natur und Leben* has often been taken as evidence of Uexküll's assumed involvement with the Nazi regime (Chamberlain 1928). On this subject *cf. below*, 38.

Central Powers with Soviet Russia not only pronounced the irremediable loss of his assets, but also implied the disappearance of the country Uexküll had known in his youth, in which Russians, Estonians and Germans cohabitated relatively peacefully.

From this moment onwards the Uexküll family, which had moved back to Heidelberg in the summer of 1917, lived merely off the wife's wealth, much less than the income from their lost property. This severely restricted Uexküll's possibility to conduct independent experimental research, and was perhaps one of the reasons that led him to devote himself more and more to theoretical works. At that time, the poet Rainer Maria Rilke, a friend of the Uexkülls since 1904, asked the biologist for biology lessons. As Rüting pointed out, "Rilke wanted to find relief from his depression in the science of organic life and its harmony" (Rüting 2004: 43).

Also in 1917, the biologist wrote *Biologische Briefe an eine Dame* [*Biological letters to a lady*], a work dedicated to his wife (von Uexküll 1919). *Biologische Briefe an eine Dame* is the outcome of a series of general-public lectures Uexküll held in the same year. During this event, in a gradual and unplanned way, his wife played a particular part: at the end of the conference, she would ask Jakob very naïve questions, to which she knew the answer perfectly well, with the sole purpose of inducing him to use a terminology that would be less specialized and more accessible to the public. The book covers key topics and concepts in the biologist's reflection, such as *Bauplan*, instinct and experience.

Due to economic difficulties and supply problems caused by the war, the family moved to Londorf an der Lumda (near Gießen) in January 1918, to the wife's younger brother. There Uexküll began to understand the full extent of the historical upheavals triggered by the end of the war and by the Russian Revolution. He as well as his wife's family were attacked by the Londorf community for false reasons and accused of being, as they were aristocrats, "parasites [and] thieves of the people's land" (von Uexküll 1964: 118). Thanks to his ability to mediate and his accommodating nature, however, the Baron prevented these disagreements from having serious consequences and from fatally compromising the relationship between the Uexküll family and the community.

On a political level, however, his opinion on the ongoing historical changes was clear: Uexküll reiterated the idea, already expressed in *Volk und Staat*, that democracy is contrary to the natural structure of the state, and even represents its degeneration. Using the metaphorical power potentially present in biological concepts, in a letter to Chamberlain dated November 20th 1917, he compared the fall of the Tsarist Empire to the dissolution of a giant amoeba in a protoplasmic decomposing mass (Rüting 2004: 44). Besides, at that time, Uexküll often quoted some verses from *Demetrius* by Schiller – "Majority is madness [. . .]. Sooner or later must the state be wrecked/when numbers sway and ignorance decides" (Schiller 1902: 380), and made them his own in the following motto: "The people have only one right – to be governed well" (von Uexküll 1964: 119). This markedly conservative attitude is reflected in *Staatsbiologie. Anatomie-Physiologie-Pathologie des Staates* [*Biology of the state. Anatomy, physiology, pathology of the state*] (von Uexküll 1920a).

Despite their difficulties, the time the family spent in Londorf was fairly peaceful, but ended dramatically in summer 1923: after a short trip to Schweringsburg, where Uexküll's wife's older brother lived (and whose health was permanently deteriorated after his return from war), the family were suddenly unable to pay for their journey back. The high inflation rate in Germany shortly after the war made the little they still owned worthless. So they were obliged to move once more and the family remained in Schweringsburg.

From the point of view of his work as a scholar, 1924 proved extraordinarily rich in positive events for Uexküll. Before we report them, we find it appropriate to volunteer the words his wife used to summarize the Estonian biologist's path until then:

> If Uexküll, shortly before his sixtieth birthday, had taken stock of his life, among the losses he would have placed his loss of faith in Germany, his abandonment of hope for a new Baltic state, and, closely linked to the loss of his Baltic properties, the end of every opportunity to be a private researcher like before. Naples, Dar es Salam, Biarritz: those scientific expeditions have been rendered impossible by his new "refugee" status. But exactly that loss could become an advantage, in that it forced him to sort, summarize and interpret the material collected up to that point. [...] The theorist had to reap what the empirical researcher [*der Praktiker*] had sown. So did this mean turning to speculation, to philosophy? Aware of the dangers this enterprise presented, but armed with the sobriety of the researcher and with a generous treasure of original empirical results, Uexküll wrote *Theoretische Biologie* [*Theoretical Biology*] (von Uexküll 1920b). With this he set himself two goals: the first was to draw a sort of summary of his observations, the second was to force his colleagues to challenge his interpretation of such observations (von Uexküll 1964: 133).

Though it was not immediately widely spread, *Theoretische Biologie* marked a turning point in the production of Uexküll. An English edition was published a few years later, which was responsible for the entry of the term *Umwelt* in the international biology lexicon (von Uexküll 1926). In Germany the work had a second revised edition (von Uexküll 1928) and many reprints,[27] although its main contents were never accepted by the academic world. As reported by his wife, "though they had recognized the importance of Uexküll's experiments on muscles and nerves, specialists would not hear about an "immaterial construction plan" – i.e. the key topic in *Theoretische Biologie*. It must have reeked too much of metaphysics!" (von Uexküll 1964: 133).

However, there are a few significant exceptions to this general attitude: Driesch stated that with *Theoretische Biologie* Uexküll left physiology behind and reached true biology (Driesch 1921: 202; Mildenberger 2007: 124), while Cohnheim not only reviewed the work positively, but also succeeded in his attempt to provide Uexküll with an invitation to the International Congress of Physiology (held in Edinburgh in 1923). The meeting was of extreme importance to German researchers, who had not taken part in international conferences since before the war (there had not been any German participant at the International Congress held in Paris in 1920). In Edinburgh, Uexküll had the opportunity to come face to face with the greatest physiology experts of the time, including Pavlov.

[27] *Cf. below*, 125, n. 30.

2.4 The *Institut für Umweltforschung* in Hamburg

Upon returning from the conference, Cohnheim contacted the academic authorities of the University of Hamburg as well as the people in charge of the Hamburg Zoological garden, with the goal to have Uexküll hired as a paid researcher. In 1924, Uexküll was appointed "assistant scientific collaborator" by the University of Hamburg. He was also presented with a possible promotion to extraordinary professor for the future. The position meant managing a laboratory and an aquarium supplied by the Hamburg Zoological Garden.

As Cohnheim wrote in his diary,

> the new title of "assistant scientific collaborator" can only put a smile on Uexküll's face, who has always regarded titles and solemnity as a little useless and who, now in his sixties, has already been awarded an honorary doctorate twice. But to be given the chance to be able to return to work, that certainly filled him with joy (von Uexküll 1964: 139)[28]

At the beginning of 1925, the biologist moved to Hamburg with his family. The aquarium at the Zoological Garden, Uexküll's new workplace, was a small facility with about a dozen of fresh and salt water tanks. It was practically derelict, because from the beginning of the war onwards management could no longer afford to pay the costs for Mediterranean and exotic fish. Under the direction of Uexküll the tanks were once again filled with marine life coming from the North Sea: mullets, wolffish, starfish, molluscs, sea urchins and sea anemones. Apart from the increase in the few visitors to the aquarium, the presence of marine animals allowed Uexküll to resume his experiments. As the aquarium did not have a real laboratory, the biologist improvised one in a kiosk originally used for selling cigarettes and peanuts. While he joked about this peculiar settlement, Uexküll never complained about it; to him, what mattered most was being able to work and to pass on his ideas to his assistant and to the students he conducted his research with.

Uexküll's tenacity and the presence of a good number of private sponsors succeeded in gradually turning that makeshift lab into a real research institute, which, in 1927, the biologist named *Institut für Umweltforschung* [Institute of Environmental Research]. The main difficulty resided in the mistrust of the official academic circles, for which the concept of Umwelt should be confined to its original area of applicability, i.e. sociology, and should not be extended to the study of the animal world. Even those who looked favourably on Uexküll and his research advised him to adopt a different name, such as *Institut für Vergleichende Physiologie* [Institute of comparative physiology]; on this point, however, the biologist held his ground.

The Institute was soon moved to more adequate premises. Administratively it was part of the Zoology Department of the University of Hamburg, and not –

[28] Also in 1924, Uexküll's sixtieth birthday was celebrated by friends and pupils with the publication of a paper in his honour: a special edition of "Pflügers Archiv für die gesamte Physiologie" (205, 1924), which contains 19 scientific contributions by authors from all over the world.

as Uexküll had hoped – of the Medicine one, whose members "were less biased against the [the biologist's] vitalistic views and did not require any profession of faith in Darwin" (von Uexküll 1964: 152). Uexküll was at the head of the *Institut für Umweltforschung* until 1936, during which time the institute became well-known on international scale, and it also made the most diverse personalities and approaches meet. Between 1926 and 1934 the Institute also published more than 70 scientific works under the direct supervision of Uexküll (Kühl 1965: 4–15; Hünemörder 1979: 105–125). From 1930, Uexküll occasionally held seminars on the philosophy of nature and the theory of knowledge together with Adolf Meyer-Abich.[29]

In 1940 Uexküll's assistant Friedrich Brock[30] took over managing the Institute. During Brock's military service and imprisonment, the Institute was managed by Emilie Kiep-Altenloh,[31] who was able to ensure its survival by training guide dogs for the blind for the German army. The dog training used an innovative method, developed by Uexküll and Emanuel Sarris[32] and based on the Uexküllian principles of *Umweltlehre.*[33] In 1959, the Institute lost its autonomy – the director of the Department of Zoology considered it outdated – and it was merged with the *Zoologisches Institut und Museum*. The teaching of *Umweltforschung* was removed from the Zoology degree programme in 1964.

[29]Adolf Meyer-Abich (1893–1971) was one of the first German philosophers to see the critical value of the concept of holism in relation to natural sciences (Meyer-Abich 1926, 1963).

[30]Friedrich Brock (1898–1958) was a German philosopher and zoologist. Originally the pupil of Driesch, he met Uexküll at the Naples Zoological Station and became his assistant at the University of Hamburg in 1925. After qualifying for university teaching in 1939, he became the director of the *Institut für Umweltforschung* in 1940, and remained so until 1945. Back in Hamburg after the war, Brock contributed to the reconstruction of the institute (Mildenberger 2007: 134–135; Brock 1939: 16–68).

[31]Emilie Kiep-Altenloh (1888–1985). In addition to her legal background, Altenloh was politically active from a young age in the ranks of the *Deutsche Demokratische Partei* and was responsible for promoting equality between men and women. When power fell in the hands of the Nazis, she was forbidden to devote herself to politics, which is the reason why she turned to biology and zoology in 1934, without meeting any political hostility at Uexküll's *Institut für Umweltforschung*. After the war she became a member of the German parliament from 1961 to 1965 (Mildenberger 2007: 170; Kiep-Altenloh 1944: 69–82, 1948: 57–59).

[32]Emanuel Georg Sarris was the pupil of the vitalist psychologist William Stern (1871–1938). Sarris worked with Uexküll at the *Institut für Umweltforschung* from 1931 to 1937 and then became a lecturer in Greek at the University of Hamburg (Mildenberger 2007: 171; Sarris 1933a, b; von Uexküll and Sarris 1931a, b, c, 1932).

[33]This method is still employed today. It is based on the principle that, since the blind man and the dog move in two different subjective environments, the trainer must take into account the perceptual and cognitive differences that exist between them. For the guide dog, for example, the height of doors is not a relevant factor, while it is for the blind human. The method developed by Uexküll and Sarris consists in tuning the two different perceptual environments together: the environment of the dog should be extended upward – by making the dog pull a cart on which is placed a mannequin as tall as a man. Every time the space the dog tries to go through is too low, the mannequin will make it impossible. Even if Uexküll and Sarris' method is a work of behaviour remodelling, it is very attentive to the subjective aspects of perception and animal cognition.

In a private note written a few years later, Uexküll retrospectively remembered some of the scholars who operated in the institution he founded:

> The *Institut für Umweltforschung* throbbed with scientific life very early. Frank[34] developed models of the swimming motion of waterfowls, which showed their expertise as divers in a large tub of fresh water at the aquarium. Kriszat[35] managed to get a mole out of its burrow using the sound of bells, which enabled him to observe in detail the movements that the animal performs in order to dig. Lissman[36] succeeded in identifying the distinctive features fighting fishes recognize to distinguish the female fish from enemies. Brecher[37] studied short-term moments in fish and long-term in snails. [...] Kühl[38] highlighted the difference between running crabs and swimming crabs. Beniuc[39] investigated the difference between the paths that fighting fish take in unknown territories and those they trace in their own territory, showing how the former appear to be more static. Brock analyzed and recorded the behaviour of mice while they were trained to perform in a circus. Sarris laid the foundation of knowledge of the dog's environment, which then served to develop a scientifically founded dog training method (von Uexküll 1964: 145; Brock 1934).

Even just from this brief review we can see how the scientific activities carried out by the *Institut für Umweltforschung* went in the same direction as the early ethology did, in the same years but with other theoretical assumptions. It was not a coincidence if even Konrad Lorenz displayed serious interest in the Institute's

[34]Harry R. Frank was a zoologist who studied at the *Institut für Umweltforschung* between 1928 and 1929 thanks to a grant from the *Kaiser-Wilhelm-Gesellschaft* (Mildenberger 2007: 136; Frank and Neu 1929: 599–526).

[35]Georg Kriszat was a Swedish zoologist. He began working with Uexküll in 1932, and soon became Uexküll's closest pupil, as goes to show the fact that in 1934 he appeared as the co-author of one of Uexküll's most famous texts, *A Foray into the Worlds of Animals and Humans* (von Uexküll and Kriszat 1934; English edition, von Uexküll 2010b), in which, however, he only dealt with the illustrations. This explains why the latest Italian and English editions of the text mention Uexküll as the sole author (von Uexküll 2010a, b). After the war, Kriszat remained true to the Uexküllian approach: in the biographical note ("Enzyklopädisches Stichwort") he dedicated to Uexküll in the 1956 edition of *A Foray into the Worlds of Animals and Humans* he tried to relate later studies by Konrad Lorenz and Nikolaas Tinbergen to his master's *Umweltlehre* (they, however, did not take position about the issue) (von Uexküll and Kriszat 1956: 163–169; Mildenberger 2007: 150, 170, 227–228; Kriszat and Ferrari 1933).

[36]Hans Werner Lissman (1909–1995) was a German biologist who left Germany in 1936 for political reasons and continued his career in England. In the period he collaborated with Uexküll his field of study lay in the motion of fish (Mildenberger 2007: 171; Lissman 1932: 65–111).

[37]The zoologist Gehrard Brecher was Uexküll's student at the *Institut für Umweltforschung* for 2 years (1928–1929) thanks to a grant from the *Kaiser-Wilhelm-Gesellschaft* (Mildenberger 2007: 136; Brecher 1933).

[38]Heinrich Kühl was a zoologist who worked at the *Institut für Umweltforschung* in the early 1930s (Kühl 1965).

[39]Mihai Beniuc was a Romanian zoologist and ethologist who collaborated with the *Institut für Umweltforschung* in the early 1930s. He was the first Romanian scholar to earn a doctorate in animal psychology. After the war he continued his scientific work at the University of Bucharest, establishing contacts with the emerging Lorenzian ethology (Beniuc 1933, 1970).

activities, which he probably visited in the first half of the 1930s, and entertained a significant personal and epistolary relationship with Uexküll.[40]

In 1928, Uexküll learnt that the Estonian government was prepared to grant compensation to the owners whose property had been confiscated due to the revolution. In the case of Uexküll, government authorities decided upon a partial restitution of land. Since the law provided for the restitution of fifty hectares for the former landowner (plus another 50 for each child), the material value of the small retrieved funds was limited. Among them, however, was the island of Pucht, which possessed great sentimental value for the Baron and which he was granted as summer residence and research station. The island is still known for the famous monument to Schiller that stands on it.

With the beginning of the 1930s, official German zoology grew even more hostile toward Uexküll. The University of Hamburg stopped accepting as doctoral theses scientific works that fell within the field of research of the *Umweltforschung*, thus preventing their authors, often belonging to the institute founded by Uexküll, from sitting the doctoral examination and obtaining the corresponding title. Those academic difficulties were worsened by the chronic lack of money that afflicted both the research institute and the aquarium, which is even more significant when one considers that the Nazi regime funded research in biology generously (it is estimated that in Germany the government contributions to biological research increased tenfold between 1932 and 1939).[41] In the same period, however, signs of appreciation from important figures in the European cultural world became

[40]Konrad Zacharias Lorenz (1903–1989) was the Austrian zoologist, of Darwinian mindset, who was the founder of the comparative study of animal behaviour (the discipline commonly known as ethology). The most intense phase of the relationship between Uexküll and Lorenz took place in the first half of the 1930s. They met in 1933 in Vienna, where Uexküll was attending a conference, and he visited Lorenz twice in Altenberg (where Lorenz conducted his experiments on jackdaws (*Corvus monedula*) in the family home). In 1934, Lorenz dedicated his study *Companions as factor in the bird's environment* to Uexküll, which might denote the theoretical connection between the two scholars at its strongest. This issue is so important in relation to the development of the Lorenzian ethology that it will be covered in Chap. 7 (see Mildenberger 2005, 2007: 159–160, 165, 169, 173, 175, 179, 199–200, 213–214, 216–217, 221–222, 224, 228, 234–235, 240; Rüting 2004: 46; Föger and Taschwer 2001: 68–69; Lorenz 1935).

[41]Deichmann 1992: 76–78. Deichmann's sources make it clear that Uexküll's antidarwinism made his theories of little use to the Nazi regime. The table in which Deichmann reports in an analytical way the amount of funding granted to German biologists between 1935 and 1945 shows that Uexküll and the institute got the modest sum of 3,700 *Reichsmark* in the first half of this period, and only 425 RM in the second half. The funds granted to Uexküll fell under "Physiology", a subject area of minor importance to the Nazis: between 1935 and 1939 physiologists received in all 62,545 RM, compared with 115,711 RM awarded to genetics and 93,854 for research on mutations. Between 1940 and 1945 physiology was granted 90,955 RM, compared with 244,273 destined to genetics and 655,728 to research on mutations.

more prominent: Frobenius,[42] Buytendijk,[43] Ortega y Gasset,[44] Spemann[45] and Portmann[46] are amongst those who valued Uexküll for his works and his research activities.

2.5 Frictions with the Nazi Regime and Death

As far as Uexküll's attitude toward Nazism is concerned, we must say that he initially welcomed the appointment of Hitler as chancellor. This can be explained on the one hand by political motivations – fear for the expansion of communism and a certain aristocratic aversion to the parliamentary system and democratization of the German society – but also by the knowledge that the new regime was in favour of the use of biological concepts in the interpretation of social phenomena and in state administration. In 1933, this awareness made Uexküll republish his work *Staatsbiologie*, in a very re-edited version (von Uexküll 1933). The book was acclaimed by Ernst Lehmann (1888–1957), president of the League of German biologists (a body with a clear long-standing National Socialist faith). As Mildenberger claims, in the introduction to this work:

> Uexküll pointed out that the state was threatened by "new diseases", [. . .] in particular the "flood" of an alien "race" and the danger of a "mass" of people out of their environments. Moreover, he despised the principle of equality, because this approach contradicted biological reality. According to him, every person was to serve the state in view of their environmental position [. . .]. As a conclusion, Uexküll called for a "state medicine" that would be able to eliminate all evil, of which he believed he had outlined the basic plan (Mildenberger 2007: 157).

[42]The German ethnologist, anthropologist and philosopher Leo Frobenius (1873–1938) was one of the main representatives of the historical school in German anthropology.

[43]Frederik Jacobus Johannes Buytendijk (1887–1974) was a Dutch physician, physiologist and psychologist. He was strongly influenced by Husserl and researched psychology and perception in animals and humans. We can find major references to Uexküll in Buytendijk and Plessner 2003: 67–129.

[44]From as soon as the early 1920s, the Spanish philosopher José Ortega y Gasset (1883–1955) encouraged the translation into Spanish of some of Uexküll's works, for which he wrote the introductions (von Uexküll 1922, 1944).

[45]The German biologist Hans Spemann (1869–1941) was particularly devoted to embryology, and he discovered the existence in the embryo of organiser centres that determine the development of the surrounding cells (Spemann 1938).

[46]The Swiss zoologist and philosopher Adolf Portmann (1897–1982) tried to counter the dominance of the Darwinian theory of evolution by means of an approach based on the importance of the morphological connections between the different living beings (thus recovering the legacy of Goethe). Portmann wrote the preface to the 1956 edition of *A Foray into the Worlds of Animals and Humans*, where Uexküll is defined as a "pioneer of new biology" (Portmann 1956: 7).

This being said, we must however stress the fact that Uexküll never associated with the anti-Semitic and openly racist tendencies of the regime, and that as early as the autumn of 1933 he showed clear disapproval of the National Socialist policy and ideology. From then on, the biologist tried to keep away from political issues, although it proved impossible in some instances.

Frictions between Uexküll and the Nazi authorities began to show during the conference *Das Duftfeld des Hundes* [*The dog's olfactory field*], held by the biologist in 1933. The conference focused on the theory, which was then universally accepted, that dogs use urine and feces as olfactory signals to mark their territory.[47] Though bearing no political implication, the conference caused a fierce reaction from Joseph Goebbels, the newly appointed Minister of Propaganda, who wrote an article on *Völkischer Beobachter* entitled *Köteraien eines deutschen Professors* [*Excremental excesses of a German professor*]. Goebbels viewed Uexküll's conference as clear testimony to the fact that German university professors were still far from having recognized "the imperative of the now": instead of "dealing with foolish and misleading things", they ought to "be urging the Germans to face their veritable duties" (von Uexküll 1964: 169).

In order to understand Uexküll's own position towards the Nazi ideology we should consider two significant pieces of evidence. The first is a letter Uexküll wrote to one of his former assistants, Lothar Gottlieb Tirala,[48] who embraced the Nazi vision of the world and became the director of the *Institut für Rassenhygiene* [Institute for Racial Hygiene] in Monaco (Mildenberger 2007: 159). The following is the most relevant part of this document.

> In the viewpoint of the [National Socialist] doctrine race there is only one rational medicine, which is to kill all the sick people – in that case the population is certainly 100 % healthy. This is a glib truth. For good measure, we should also eliminate the consequences of domestication, which is known to lead to the appearance of harmful mutants, and return

[47] At the end of the conference, the philosopher Ernst Cassirer, who moderated the event, opened the discussion with this sentence: "Rousseau said that the first man who, having enclosed a piece of ground, bethought himself of saying "This is mine" should have been killed. After Professor von Uexküll's lecture, we know that this would not have sufficed. The first dog would have had to be killed too" (von Uexküll 1964: 24; Mazzeo 2010: 16–17).

[48] Lothar Gottlieb Tirala (1886–1974) was an Austrian biologist and physician and a pupil of Uexküll. In the 1930s he became friends with Chamberlain (probably through Uexküll). A convinced Nazi, in 1933 he was appointed professor at the Institute of Racial Hygiene, University of Monaco. In his works he repeatedly tried to compare the Uexküllian theoretical biology to the National Socialist biological vision of the world. In his book *Rasse, Geist und Seele* (Tirala 1935) Tirala used the Uexküllian concept of environment for political purposes, stating that human races live in different Umwelten and are therefore radically separated from each other. Unlike Uexküll, Tirala claims, however, that the environments of different races are hereditarily determined. After the war, Tirala's scientific activities and publications turned to alternative medicine and therapies based on breathing (Stella and Kleisner 2010: 47; Mildenberger 2004).

> to the primary forest. And this is indeed the ideal of many race theory enthusiasts. But these youths, from the vantage point of those principles, also wish to eliminate all the individuals with "foreign blood" in their veins. That is where miserable materialism that spread with the doctrine of the race reaches. Now only the hereditary material is taken into account, and the construction plan [*Bauplan*] of the organism is utterly ignored. But the Darwinists already did just that (von Uexküll 1964: 169)[49]

The second expression of Uexküll's attitude regarding National Socialism is a letter dated May 1933 which the biologist addressed to the widow of Chamberlain,[50] a scholar with whom Uexküll had entertained a friendly epistolary relationship (Mildenberger 2007: 92). He chose to write to Eva Chamberlain[51] because she belonged to the circle of direct acquaintances of Hitler, so this letter was Uexküll's attempt to be heard by the highest levels of the government. Below are some of the most significant passages.

> I am turning to you prey to a very serious concern, that of maintaining the purity of the reputation of the great man who was your husband. [. . .] Due to the fact that he developed a superb race theory in his book *The Foundations of the Nineteenth Century*, particularly concerning the Jew issue, friends and foes now believe that he was the intellectual promoter of the anti-Jewish measures taken by Hitler's government. Actually, what is happening is heading in the opposite direction compared with what he professed [. . .].
>
> If Chamberlain could see what is taking place today, he would vehemently protest and would use all the authority granted to him by his moral stature against the idea that he, who all his life was the supporter of the purest idealism, is now regarded as the promoter of the pettiest materialism.
>
> What happened?
>
> The University of Hamburg dismissed the world-renowned philosopher, Prof. Cassirer,[52] although should be given credit for giving a new life to the philosophy of Kant. [. . .]

[49]It should be noted that the fear that the comforts of modern life could have the same degenerative effects on humanity as those domestication seems to have on animals was taken seriously by many naturalists of the time. The most significant case is perhaps Konrad Lorenz, who (on a theoretical level) explained the reasons for adhering to the National Socialist Party and supporting the *Anschluss* of Austria in the hope that the Nazi regime would somehow be able to oppose this process (Föger and Taschwer 2001: 99–119).

[50]The correspondence between Uexküll and Chamberlain was analyzed by Schmidt who detected anti-Semitic positions in both authors (from which Uexküll later distanced himself; *cf. below* 37–38) (Schmidt 1975: 121–129).

[51]Eva Wagner Chamberlain (1876–1942), daughter of Richard Wagner, married Chamberlain in 1908.

[52]Ernst Cassirer (1874–1945) was a German Jewish philosopher. His field of study ranges from a Kantian epistemology to the philosophy of symbol and culture. After taking refuge in the United States in 1941, he taught at Yale University and Columbia University until his death. On the relationship between Uexküll and Cassirer *cf. below*, 188; van Heusden 2001.

> Gone is also the brilliant Jew Haber,[53] who managed to separate nitrogen from the air and employed it for the manufacture of ammunition. [. . .] The most talented urbanist in the world, Schumacher,[54] was recently dismissed. [. . .]
>
> [They and many others] were honest and conscientious people, who had dedicated their lives for the good and honour of Germany. Those who do not have at least 75 % Aryan blood are expelled. This is the worst form of barbarism.
>
> [. . .] The thesis of the *Studentenschaft* in Berlin "If a Jew writes in German, he is lying" is now regarded as the quintessence of Chamberlain's doctrine. Thus, all that is actually achieved is the destruction of the profound truth that Chamberlain announced: "Respect for the individual, whether they are Aryan or Jewish, is the highest moral precept".
>
> [. . .] My most esteemed friend, you have influence over Hitler. Please write to him, and urge him to utter a word of conciliation in order to strike this so un-German situation like a thunderbolt and to put an end to it.
>
> In great fear for Germany and in memory of my true friend,
>
> Yours devotedly,
>
> J. v. Uexküll (reported in von Uexküll 1964: 173; see also Mildenberger 2007: 158–159; Rüting 2004: 42; Schmidt 1975: 127)

This letter remained unanswered.

In 1934, by then in his seventies, Uexküll published with Kriszat his work that was to become the most successful in terms of readers, *A Foray into the Worlds of Animals and Humans* (von Uexküll 2010b). The book is dedicated to his friend Otto Cohnheim who "lost his appointment as a university professor because of racial politics" (von Uexküll 1964: 187). The same year, on his seventieth birthday, Uexküll received a case containing scientific papers published by international scholars,[55] as well as an honorary doctorate from the University of Kiel (the third one in his life. He was awarded the fourth one by the University of Utrecht in 1936).

Another disagreement opposed Uexküll and the supporters of the National Socialist worldview in 1936. Upon the invitation of the Academy of German law, the biologist held a conference on philosophy of law at the *Nietzsche-Haus* in Weimar. Before taking part, Uexküll required a clear statement that the Academy had not invited him to teach him a lesson, but only to listen to his contribution. Reassured by the university authorities, Uexküll decided to put in a word in defence of freedom

[53] Fritz Haber (1868–1934) was a German Jew who specialized in the thermal reactions of gases. Haber was professionally active both in the German academic world and in the industrial one. Part of his research led to the development of gases for war purposes. In 1919, he was awarded the Nobel Prize for chemistry. Despite having converted to Christianity in 1900 and enjoying a good reputation in Germany, he had to emigrate in 1933 to escape the anti-Semitic policies of the Nazi regime.

[54] Fritz Schumacher (1869–1947) was a German Jewish architect and urban planner. Professionally active in Dresden and Hamburg, he made a significant contribution to the understanding of urban problems posed by the development of modern industrial cities (Schumacher 1940).

[55] *Festschrift*, published in a special issue of the journal "Sudhoffs Archiv" (journals 3/4 dated 1934), involved Lorenz, Meyer-Abich, Brock, Tirala and others (Mildenberger 2007: 163–166).

of teaching and research – just as German universities were being covered in posters bearing slogans like "Against the enfeebling caused by the debilitating objectivity of science" (von Uexküll 1964: 174).

The cultural event was opened by Nietzsche's sister, Elisabeth, and it soon became clear that the situation was not prone to express any opinion that differed from the directives of the party. Uexküll was allowed to continue until he pronounced the following statement:

> Nowadays, as a criterion of vitality and skill we are expected to return the blow we receive. This criterion, however, as biology teaches us, only applies to effector organs. The eye that is punched can only become blind, but cannot punch back. And the task of universities is precisely to be the eyes of the state (von Uexküll 1964: 175)

At that stage the audience interrupted Uexküll's presentation and he left, but not without recommending (in private) the organizers read Chamberlain's work *Worte Christi* [*The words of Christ*] (Chamberlain 1901). From then on Uexküll was constantly watched by the party. His book of personal recollections *Nie geschaute Welten* [*Worlds never seen*], which contained words of appreciation for the Russian Jews and the Baroness Rothschild (von Uexküll 1936: 216), was officially banned from being displayed in the windows of bookshops. As a scientist Uexküll was accused of professing a Marx-inspired theory of environment, and to consider man as a product of his social context (milieu). This accusation, which fundamentally misunderstands the Uexküllian theory of environment (Umwelt), made the public regard the biologist even more suspiciously.

In April 1936 Uexküll was dismissed on account of his age with a very small pension (145 marks). The summer of 1939, which he spent with his family on the recovered island of Pucht, is the last relatively peaceful time for the biologist. In 1940 his heart problems he had been lamenting for some time got worse, so Jakob and his wife decided to move to Italy to enjoy a healthier climate. The chosen destination was the island of Capri, where Uexküll died on July 24th, 1944. The U.S. authorities, who were occupying the island after the liberation of Naples and who had established a friendly relationship with the elderly couple, offered the only priest available, a young rabbi from Vienna, who celebrated a simple ceremony in the presence of a small number of people. Invited to deliver a short commemorative speech, the mayor of the island recalled his last conversation with the deceased (dedicated to the structure of a flower) and concluded the funeral service with the words: "This man maintained a constant dialogue with the Creator" (von Uexküll 1964: 264). Jakob von Uexküll's grave is on the island of Capri.

The *Institut für Umweltforschung*, despite the academic authorities' intent to have it suppressed, managed to survive thanks to the services rendered training guide dogs for the blind. This field of activity, directed by Emilie Kiep-Altenloh, imparted strategic importance to the institute in time of war. In 1940, the helm was taken by Friedrich Brock, but he was immediately enlisted and was left unable to continue the scientific research that characterized the school in previous years. Thanks to the laws of time, which encouraged the career of scholars who served in the military, on his return Brock was appointed extraordinary professor of *Umweltforschung* at the University of Hamburg.

With the end of the Third Reich, the *Institut for Umweltforschung* lost its main sponsor, the National Socialist state, whereas its training dogs for the blind service was more necessary than ever. In view of these difficulties, the end of 1945 witnessed a phase of intense disagreements and oppositions between Uexküll's followers: Emilie Kiep-Altenloh, whom the rector of the University of Hamburg appointed as interim director of the *Institut* until Brock returned from captivity, separated the dog training activity from the scientific research (for the former she founded a specific foundation, the Jakob von Uexküll Foundation for the training of guide dogs). From a theoretical point of view, she also wanted to substantially alter the Uexküllian environment theory, by connecting it to the findings of contemporary biology. On his return, Brock regarded Kiep-Altenloh's choices as a sort of betrayal, and in 1947 (with the help of another of Uexküll's pupils, Heinz Brüll) he succeeded in excluding her from all of the institute's activities and Brüll took her place at the head of the institute (Mildenberger 2007: 210–211).

Under the direction of Brüll, not one of Uexküll's brightest brilliant students, the institute began going downhill. In the early 1950s, Sarris put an end to his activities at the University of Hamburg and broke all ties with the institute, which thus lost its last valid scientific assistant. From 1952 onwards, leadership of the institute was taken on by Brock, who proved neither able to foment scientific research, nor to defend Uexküll's theses on a theoretical level (by the mid-1960s, such theories were abandoned, being deemed old-fashioned and utterly unscientific). With the death of Brock, in 1958, the *Institut für Umweltforschung* was permanently closed. Finally, in 1964, the University of Hamburg replaced the chair of *Umweltforschung* Brock had held until his death, with Ethology (taught by the Department of Psychology). The disappearance of the institute and the lack of a real Uexküllian school do not mean, however, that Uexküll's work stopped influencing biology, anthropology, ethology, philosophy and semiotics in the following decades, starting from the 1970s. For a closer look at the "rediscovery" of Uexküll and the many contributions that the concept of *Umwelt* volunteered to contemporary thought, we refer to Chap. 7 of this work.

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Chapter 3
The Basis of the Environmental Theory

Abstract The chapter describes the basilar elements of Uexküll's theory of life. Starting from the biologist's position in the quarrel between vitalists and mechanists, it introduces some key points that accompany his whole reflection, as the concept of *Bauplan* (building-plan) and the problem of protoplasm. The chapter also proposes a periodization of Uexküll's production according to the prevailing interests and topics: a first period dedicated to the physiology of marine animals, a second period in which the results of the physiological research coexist with emerging theoretical interests, a third period almost entirely devoted to theoretical biology, the definition of the *Umwelt* theory and the problem of the animal subjectivity.

Keywords Mechanist-vitalist debate • Physiology • Reflex theory • Building-plan • Milieu • Protoplasm

3.1 Uexküll's Position in the Mechanist-Vitalist Debate

In relation to our purpose – which is to outline Uexküll's conception of living organisms in their relationship with the environment – it is inevitable to face the issue of his stance on the most important debate in modern theoretical biology: the quarrel between vitalists and mechanists. This debate is linked to the nature of life, one of the most controversial issues in the history of philosophy and medicine, which underwent a remarkable revival in the years where Uexküll was active. After briefly setting out the conceptual core of this problem, our reconstruction will rapidly consider the conception of vitalism and how it unfolded in previous centuries. Finally, we will focus on the authors and argumentations that, in Uexküll's period of activity, revitalized and modified Vitalism to such an extent that it became necessary to introduce a new name, i.e. Neovitalism.

One of the main tasks of theoretical biology is to understand what differentiates a living organism from an inanimate body. The features that have always been identified as distinctive to living organisms concern the capacity of movement, the unitary nature of the system formed by them, the ability to auto-regulate themselves in a manner consistent with changing external circumstances, and the possibility to reproduce respecting the basic characteristics of the system. None of these properties can be found – or at least they are never found all together – in systems

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formed by inanimate bodies, and this contributes to defining the phenomenon of life (and hence also the field of biology). From an explanatory point of view, these properties can be considered in two ways: either as a highly complex result of the laws of matter (that is, in modern times, of the laws of physics and chemistry), or as the result of a force or element that, although extra-material itself, is able to act on matter and brings it to a new and higher level of organization. The first position is called materialist or (since the seventeenth century) mechanist, the second one animist or vitalist.

Before the disciplinary separation between philosophy and natural science triggered by the scientific revolution, the main theories of the living could be found in the works of philosophers. Despite the multitude of alternative approaches, the dominant view was Aristotelian vitalism for all of antiquity and the Middle Ages. Throughout these centuries the Aristotelian concept of the soul – which assumes the name entelechy in its specific use in biology (*cf.* Aristotle, *De anima*, iii, 7, 431 a 1 and *De generatione animalium*, ii, 1, 734 a 30, b 21) – seemed to explain all the typical properties of living systems: for Aristotle the soul is a formal, organizational and unifying principle. Movement is also attributed to it, and its inaccessibility to corruption makes it the privileged intermediary for the transmission of species-specific characteristics to subsequent generations. Seeing the soul as the principle of life means, however, extracting it from matter: if the vivifying instance is extra-material, matter itself is at best passive, receptive, but not able to auto-regulate itself or reproduce.

In addition to what status – material or extra-material – should be given to the basic principles of the living, mechanists and vitalists also disagree greatly on what type of causal links should be allowed in biology. Following the Aristotelian hylomorphism, vitalists deem as final those causes essential to a proper understanding of living organisms; in particular, the coordinating action of that "immanent purpose" which is the adult organism seems to be essential, particularly in embryology, where you have to account for the formation of a new organism from what appears to be nothing more than a piece of undifferentiated matter (e.g. the egg).[1] Given the lack of knowledge available, it often seems impossible that matter – whose limit was, already for the Greeks, passivity – can spontaneously produce organs and complex structures. It therefore becomes almost inevitable to turn to the influence of an extra-material and extra-temporal entity, precisely entelechy, which affects matter as the "representative" of the future state of the organism. In metaphorical terms, the reference to final causes allows us to consider the future state of matter – the adult organism, but also (as in the Aristotelian theory of natural places) the final position of the four physical elements – like a sort of magnet that acts in time "attracting" and directing transformative processes. In embryology this explanatory model will prove to be very long-lasting, and its final demise will occur only with the discovery of DNA, which rules out the conception of matter as a passive substrate and shows

[1]Following Aristotle's interpretative thought, in the medieval times Thomas defines the teleology within the living matter as a *causa immanens* (Smith 1955: 212–215, 223).

it instead as able to "read" other matter (DNA sequences contained in the genes) and thus to trigger the development of the adult in all its complexity.

The mechanists, for their part, totally reject the existence of final causes in favor of mechanical or antecedent causes; that is of easily identifiable events that are the origin of the changes of matter and energy that we are called upon to explain. This substitution between types of causes, whose importance in the modern scientific revolution cannot be overestimated, first affected physics, then gradually expanded to biology and finally attempted to establish itself in psychology. The process is not always straightforward: in biology, for example, the low level of scientific knowledge and the refined conceptual instruments of the vitalists often make the mechanist ideas appear naive (as we shall see further on, this will happen to the preformist assumptions in embryology).

In modern times, the dominance of Aristotelianism in theoretical biology is lessened due to two lines of criticism. The first line is philosophical, within which the main attacks on Aristotelian vitalism come from Descartes and Kant. The former drastically reduces the presence and action of the soul compared with the Aristotelian and medieval concept of the living: for Descartes only man possesses a soul, and that soul clearly coincides with reason (or *res cogitans*). As a result, not only are the other kingdoms of living beings deprived of the types of souls that Aristotle provided for them (the vegetative soul for plants and animals, the sensitive soul for animals), but also man himself becomes a body in the mechanist sense of the world, i.e. a body-machine to which is added, in an inexplicable and problematic manner, the rational soul. This profound transformation of the thought context cannot but have an impact on the explanations advanced by Descartes regarding animals: if their organization can no longer be explained by the organizing principle of the soul, Descartes is left with much more basic dynamics: hydraulic thrust to explain physiological processes, reflexes and reflex actions for behavior.[2]

As far as Kant is concerned, the *Critique of Pure Reason* can be seen as a formidable theoretical support to the scientific revolution, and in particular to the process of replacing final causes with antecedent causes. In his view, every event in the natural world can be understood with scientific certainty only if it can be attributed to antecedent factors; science can indeed operate with legitimacy only within the basic coordinates of intuition (space and time) and intellect (categories, among which antecedent causality play a major part). Moreover, in the Kantian perspective, although this tendency of the human mind cannot be eliminated, the explanatory recourse to teleological factors that appears to happen out of time and out of space (such as entelechy and other vitalist concepts) does not produce certain knowledge but only a semblance of knowledge.

The second line of criticism on Aristotelianism and vitalism comes from empirical research: after the seventeenth century the diffusion of the experimental

[2]For Descartes reflex action is not only the paradigm for animal behavior, but also for every sort of behavior carried out by man in conditions of the suspended control of the rational soul (reactions to sudden strikes, sleepwalking, states of extreme passion etc.) (Brentari 2010: 592–594).

verification of theoretical hypotheses helps to discredit vitalism, primarily from a methodological point of view. The intangible nature of the vital principles postulated by vitalists themselves, which makes them *de facto* uninvestigable, is often sufficient to discredit them from a scientific point of view.[3] From that point on vitalism could be supported only indirectly, i.e. by showing the explanatory inadequacy of specific mechanist hypotheses and by presenting phenomena that, in the absence of a chemical-physical explanation, seem to require the recourse to extra-material instances. This will be the strategy followed by the main exponent of neovitalism, Driesch, who will try to prove the existence of entelechy based on the phenomenon of the parallel development of embryonic tissues separated during the experimentation phase.[4]

Between the seventeenth and nineteenth centuries, theoretical biology witnesses the alternating hegemony of mechanists and vitalists, without either of the two currents prevailing permanently. The context is very heterogeneous because the debate between the two theoretical macrosystems occurs in the concrete setting of the interpretation of single scientific discoveries, and therefore depends on a large number of contingent factors (new investigative tools, new knowledge in the fields in question, etc.). There are also many in-between positions, which combine elements of mechanism and vitalism in original syntheses, often directed at providing an *ad hoc* theoretical background for the work of individual scholars.

That being said, it is still possible to try to outline a general overview of the debate that took place in modern times between the two approaches. The seventeenth and eighteenth centuries are predominantly mechanist and rationalist; they tend to reject outright the idea of extra-material forces organizing living things (like the soul, even in its Cartesian understanding). In that period, the analogy with the clock, or with the machine (Cimino and Duchesneau 1997: 32; Mazzolini 2003: 29–30), seems to be much more befitting and enlightening in order to grasp the nature of living things. One of the figures to embody the attitude that spreads during the Enlightenment is the Dutch physician Boerhaave,[5] who believes the body is a system with functionally different gears and contains no supersensible or extra-material entities. Julien de la Mettrie, the Enlightenment philosopher who followed in Boerhaave's wake, will make the mechanist approach famous through

[3]On this aspect of the argument, one of the major attacks to vitalism was the experimental confutation of the Aristotelian theory of spontaneous generation, which had already appeared with the seventeenth century physician, entomologist and parasitologist Francesco Redi (1616–1698) and carried on by the biologist and physiologist Lazzaro Spallanzani (1729–1799) (Redi 1997; Spallanzani 1785).

[4]Cf. *below*, p. 53.

[5]Hermann Boerhaave (1668–1738). Dutch physician, chemist, theologist and philosopher. Taught at the University of Leiden. A versatile figure whose interests ranged from the re-editing of medical-philosophical texts from antiquity (like those of Aretaeus of Cappadocia) to the issue of contemporary Cartesian and Newtonian theories. From a theoretical point of view he paid great attention to the internal dynamics of the body (circulation, most of all), which he interpreted as primarily hydro-mechanic; see Mazzolini 1996: 164–167.

his work *Machine Man* (1748) (de la Mettrie 1996). In the nineteenth century, the main supporter of mechanism is Haeckel,[6] who combines this approach with his strong belief in the Darwinian theory of natural selection. He is therefore a major contributor to the deterministic interpretation of Darwinism that spread in Europe in the nineteenth and twentieth centuries.[7]

Despite the prevalence of the mechanist mindset, vitalism did not disappear in the seventeenth and eighteenth centuries either; as a matter of fact a number of original views emerged alongside the revival of Aristotelian or magical-alchemical concepts (the latter being of Renaissance origin). On the philosophical side, the vitalist approach is clearly present in the work of Leibniz, who is convinced that mechanism (though influential in physics) fails to account for one of the most characteristic features of living things: harmony. Whether we consider the individual organism, all living beings, or even things on a cosmic level, according to Leibniz, the harmony of relations between parts can only be explained by allocating vital spontaneity and procedural autonomy to matter. These features come from it being animate matter, i.e. matter in which spiritual realities or monads occur in an immediate and invigorating way. The connection of the monads with one another is ensured by their participation in the God monad, ultimately responsible for harmony in the world.

On the scientific front, in the eighteenth century some of the main advocates of the vitalist current were doctors and scientists, such as Bichat[8] and Stahl.[9]

[6]Ernst Haeckel (1834–1919). German physician and zoologist. Beginning from the 1870s he earned significant fame as an unwavering supporter of Darwinian theory, to which he provided a popular, instructional version. Among Haeckel's students we also find Hans Driesch. However, Haeckel would later distance himself from Hans Driesch definitively.

[7]Uexküll's criticism of Haeckel is even more severe than his attacks to Darwin are. Haeckel is described as a materialist and enemy of the teleological conception of nature, whose philosophical ideas – due precisely to their low level and ease of comprehension – would spread among the masses with detrimental effects: "This doctrine caused the mass of the people to lose the idea that the individual human being is a planned harmonious unit, which needs to be developed in all directions [. . .] and man becomes a more or less random conglomeration of properties" (von Uexküll 1913: 132).

[8]Marie-Francois-Xavier Bichat (1771–1802). French surgeon, physiologist and anatomist. He can be placed among the supporters of Stahl and the adversaries of Boerhaave. Bichat is responsible for the definition of life as "the ensemble of functions that resist death" (Bichat 1829: 1), a definition based on the distinction between the "physical properties" and "vital properties" of organic tissue. According to him, the first are the qualities of matter that remain unmodified after death (extension, for example), while the second includes qualities that are autonomous and cannot be reduced to physical laws, such as contractility and sensibility. This distinction, which includes key features of vitalism and neovitalism, would be quite popular with future authors – from biologists such as Claude Bernard (*cf. below*, 52, n. 13) and Uexküll himself (*cf. below*, 69), to philosophers such as Schopenhauer and Plessner (see Schopenhauer 1969: 261–272; Plessner 1975: 112). For an introduction to this author see Rey 1997: 175–204.

[9]Georg Ernst Stahl (1659–1734). German physician and chemist. Staunch anti-Cartesian, he opposed the prevalently mechanist tendencies of the time by supporting a form of accentuated vitalism (of which he is considered one of the main representatives in modern times). His theory of living things is inspired by the clear dichotomy between spirit and matter, which he however intended to overcome: the soul is seen as an immaterial force capable of vivifying matter, which

Stahl's position deserves to be briefly detailed: although he was convinced that the functioning of the body could be investigated mainly from a chemical standpoint, he also believed that the chemistry of living things was irreducible to the dynamics that take place in inanimate matter.[10] He traces back the specificity of the organic – which manifests itself on the one hand in embryogenesis, and on the other in the harmonic organization of the living – to the influence of the soul; according to Stahl the soul builds the body itself, it preserves and acts in and on it with a precise aim (Dröscher 2008: 191).

Stahl's approach allows us to highlight a significant step: from the end of the seventeenth century the most convincing vitalist proposals were the result of the inclusion of mechanist ideas into a theoretical framework characterized by the persistence of concepts like soul and final cause. This step concretely shows that medieval Aristotelianism, as well as conceptions of magic, alchemy and Neoplatonic Renaissance-style ideas were overcome, which makes it necessary to consider the approach of scientists like Stahl and Trembley[11] separately and we need to adopt the specific term of neovitalism to refer to the later positions of Driesch, Reinke[12] and in a certain way of Bernard[13] and Uexküll[14] himself. The neovitalist approach has among its fundamental traits the aspiration to prove experimentally

in itself is dead mechanism. As it is inaccessible to direct empirical enquiry, the soul becomes an object of study thanks to its effects on the body (among which we find the possible rising of pathologies).

[10]In confirmation of how varied and diversified this theoretical framework would be, a similar position was held by Pasteur (who certainly was no classic vitalist) about fermentation, which he saw as a vital process that was not reducible to the laws of inorganic chemistry (Pasteur 1858: 9).

[11]Abraham Trembley (1710–1784). Swiss zoologist, one of the initiators of the modern studies of regenerative physiology (Trembley 1744).

[12]Johannes Reinke (1849–1931). German botanist and philosopher, interested in cell theory, specifically in the formation of cytoplasm. His affinity to neovitalist conceptions is clear in his assumption for which immanent "systemic forces" of immaterial nature (which he calls "dominants") were in action in organisms (Reinke 1911, 1919).

[13]Claude Bernard (1813–1878). French physiologist who dedicated the first part of his career to in-depth research on human metabolism (specifically the processes of glycemia and vasoconstriction). After 1850, he focused on the drafting of theoretical-philosophical works which dealt with methodological and epistemological issues (criticizing Comte's positivism, among others). Bernard developed a holistic approach based on the concept of the internal environment, meaning the idea that every biological event – far from being isolated reactions to a single stimulus, or the effect of a single cause – is the result of the regulating activity of the entirety of the organism and the processes acting within it. For an introduction to this author see Holmes 1997: 281–286.

[14]The use of the term "neovitalism" is not universally accepted. It is commonly found in German, Italian and French authors, while it is less common in Anglo-Saxon contexts. It is not mentioned in *The Oxford Companion to the History of Modern Science* (Heilbron et al. 2003) nor in the *Routledge Encyclopedia of Philosophy* (Craig 1998); not considering the hylomorphic theories of antiquity and the Middle Ages as a part of vitalism, the *Routledge Encyclopedia* limits the use of this term to the eighteenth and nineteenth centuries, thus avoiding the adoption of a new denomination (that of neovitalism) for the position of Driesch and other contemporary authors. The same approach is found in Cimino and Duchesneau 1997.

the existence of the organizing instance that underlies living things, and that is given different names depending on the author: *vital force* for Bernard, *entelechy* for Driesch, *dominant force* for Reinke, *natural factor* for Uexküll.

The experiments conducted by Trembley on freshwater polyps or hydras (*Hydra vulgaris*) come under the earliest examples of the empirical vocation of modern vitalism. Trembley starts from the observation that, after cutting a freshwater polyp (also called hydra) into two parts, the body regenerates itself to reconstitute two fully complete animals. Trembley gives a vitalist explanation for this phenomenon: if the body were a mechanism, its division would result in its complete destruction. Only the presence of an immaterial instance which is not compromised by the division itself can trigger the regeneration process – the same conclusion that, more than a century later, Driesch would draw from his experiments on the dissection of sea urchin eggs (Driesch 1899: 9–11). The vital phenomena that neovitalism considered particularly apt to reveal the action of the vital force are primarily regeneration and parthenogenesis, although nutrient intake and "irritability" (i.e. the body's ability to respond to stimuli not automatically or by reflex, but depending on the intra-organic needs at a certain time)[15] often appear mysterious too.

From the end of the eighteenth century, in other words, both mechanists and vitalists can no longer simply theoretically establish their theses but must resort to experimental verification. Dröscher speaks in this regard of a "third address" alongside mechanism and vitalism: empiricism (Dröscher 2008: 196). One of its most significant exponents is the Swiss scientist Albrecht von Haller[16]; a student of Boerhaave and trained mechanist, he focuses his research on the concept of function, trying to identify what moves the anatomical structures and especially the organs. Starting from a solid experimental basis – Haller observes, for example, that an explanted heart continues to pulsate for a certain amount of time – he proposes the theory that responsible for the movement of body structures is the "fiber", when it is hit by a force called irritability (*vis irritabilis*). According to Haller both the fiber – conceived as the micromechanic unit of the body – and the *vis irritabilis* are not actually empirically observable realities; their understanding can only avail itself of the investigation of their effects.

Although they arose in a mechanist theoretical context, Haller's ideas were often given a vitalist interpretation, especially in the German Romanticism. The *vis irritabilis*, designed by Haller as an absolutely natural force, is indeed a specificity of living things, and can therefore be used as an anti-reductionist argument. Haller's

[15]Barsanti writes in this regard: "It seems to me that the dwindling of mechanical philosophy [. . .] can be seen as the effect of three distinct beliefs: (1) that the living nature is – as was said – much more "varied" and "complicated" than what mechanists postulated; (2) that when you look at them from the perspective of "mechanical philosophy" certain of its phenomena are so "extraordinary" and "abnormal", so "unusual" and "surprising" [. . .] that it is very doubtful that it can ever explain them; and finally (3) that not only those exceptional phenomena, but also the more ordinary phenomena of living nature must be radically reinterpreted" (Barsanti 1997: 67–68).

[16]Victor Albrecht von Haller (1708–1777). Swiss botanist, anatomist and physiologist. For a more in-depth introduction to this author, see Monti 1997: 41–66.

approach also legitimizes the idea of the legitimacy of inference from visible effects to invisible causes. It is mainly for the latter reason that, in connection with Haller's studies, a philosophy of nature and a new kind of scientific practice developed in nineteenth-century Germany, for which the definition of "materialist vitalism" used by Dröscher is most fitting (Dröscher 2008: 199).

Uexküll's theoretical biology has its roots in this empiricist or "materialistic" current of vitalism. In fact, a straight line connects the figure of Haller to scientists like Müller and von Baer, who can be considered direct mentors of Uexküll. This line also encompasses Wolff,[17] with his hypothesis of a *vis essentialis* that explains the unified and harmonious development of the single organism, as well as Blumenbach,[18] for whom a vital force (*Lebenskraft*) or a formative impulse (*Bildungstrieb* or *nisus formativus*) are at work in the processes of generation and development. Blumenbach is one of the first to use the term building-plan [*Bauplan*], which, as we will see, has a central role in the work of Uexküll.

These conceptions are based on the idea that living things should be studied using a pluralistic approach. To the mentioned authors, what is empirically observable of living matter is also legitimately interpretable in mechanist terms (although not necessarily reductionist ones); beyond this sphere, however, it is necessary to assume there are extramaterial forces that, more or less explicitly, have a holistic, teleological and harmonizing influence on matter. Uexküll, perhaps the last of the vitalists from an empiricist mold, does not only share this position, but gives it an eminent theoretical foundation: turning to Kantian philosophy, he associates the empirically observable sphere of the living with the phenomenon, and the sphere of extramaterial forces with the noumenon. His intent is reminiscent of Kant's: according to Uexküll, limiting the scope of enquiry to the phenomenal world should have meant an increase in the accuracy and certainty of science, while the use of unverifiable assumptions and hypotheses regarding the sphere of noumenon (for instance the existence of an unknowable natural factor) should only have been of heuristic and orientative value.[19]

[17]Caspar Friedrich Wolff (1734–1794). German biologist, known for his absolute refusal to the preformist theories of the formation of the embryo and his support of the opposing concept of epigenetics (Wolff 1764). Wolff dedicated his final years to reflections on the forces active in the formation of the individual; one of his ideas of particular note (which he proposes in opposition to Stahl's conception) suggests that the *vis essentialis* should not be identified in the least with the soul but rather would have a material nature (Wolff 1789).

[18]Johann Friedrich Blumenbach (1752–1840). German anthropologist, anatomist and natural historian. Besides the biological notions mentioned here, which are intended to defend epigenesis from preformist theories, his fame is tied mainly to his role as founder of German scientific anthropology, and specifically the fact of having been one of the first to suggest the analogy between man and domesticated animal as a scientific hypothesis.

[19]Mildenberger correctly states: "The denial of the existence of an "objective world" makes [Uexküll] rely completely on subjectivistic elements from Kant's philosophy and ignore Aristotle's views, unlike the other vitalists" (Mildenberger 2007: 194). However, if it is important to note

3.2 Periodization of Uexküll's Production

Uexküll's scientific production can be divided into three periods according to the prevailing interests and topics. The first period covers his education and training years and stretches roughly from 1892 to 1909, when the biologist presents his research method and the results of the empirical research he carried out. In the second period, from 1910 to 1918, Uexküll combines empirical research with theoretical reflection. The third period (from the end of World War I to his death) is primarily made up of theoretical works. In the following paragraphs we will try to provide a summary of the three periods identified.

The empirical research which the writings of the first period are dedicated to focuses mainly on the physiological context; they are displayed in a number of studies and articles on reflexes, on the functioning of nerves and muscles, and on the physiology of perception and movement. Uexküll mainly deals with marine invertebrates (sea urchins, sea cucumbers, etc.). These studies are published in important specialized journals of the time (particularly in "Zeitschrift für Biologie" and "Zoologischer Anzeiger"). The articles were then followed by the first major monograph, *Leitfaden in das Studium der experimentellen Biologie der Wassertiere* [*Guide to the Study of the Experimental Biology of Aquatic Animals*] (von Uexküll 1905).

As regards this work, which aims to reconstruct the developing stages of Uexküll's conception of environment and philosophy of life, the first period is particularly significant for the introduction of two concepts which will remain central throughout the following production: the concept of purposiveness (*Zweckmässigkeit*) of the living and that of building-plan (*Bauplan*). We can also trace back to it an important antecedent of the concept of environment: the concept of milieu, which anticipates that of Umwelt (a foundation of Uexküllian theoretical biology). Reserving the term "environment" as the translation for Umwelt, we will translate *milieu* as the typical "context" of every biological species.

The second period of Uexküll's production begins with the publication of one of the most noted of his works, *Umwelt und Innenwelt der Tiere* [E*nvironment and Inner World of Animals*] (von Uexküll 1909; partial English edition consulted: von Uexküll 1985). This work marks a turning point not only because its use of the concept of *Umwelt* becomes self-aware and systematic, but it is able to respond to very precise demands which were born from field work (as we shall see through the analysis of this work, the concept of Umwelt was born in close connection with the physiological research on marine animals that Uexküll was conducting in these years). The next work, too, falls into this second period; *Bausteine zu einer biologischen Weltanschauung* [*Elements for a Biological Vision of the World*] (von Uexküll 1913), a collection of his most significant articles from 1907 to 1912.

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the lack of expressly Aristotelian notions (such as entelechy, which had been taken up by Driesch), Uexküll is set in a theoretical context of a teleological sort that indirectly descends from Aristotelian biology.

This work testifies to the necessity that Uexküll feels to go more in-depth into the philosophical background of the scientific results he obtained. Ever aware of the new importance that biology was assuming in shaping Western society's vision of the world thanks to Darwinism, Uexküll attempts to demonstrate how Darwinism and Haeckelism – primarily read as a doctrine centered on the struggle for survival as a form of mechanist determinism – are not the only scientifically sustainable biological *Weltanschauung*. Darwin and Haeckel are systematically countered by representatives of the teleological vision of nature, from Kant (who is also used in the transcendental foundation of the biological subject) to von Baer and Müller.

The end of this second period came with the First World War and the loss of Uexküll's family assets. These two events force Uexküll to halt his activity of direct experimentation in order to concentrate on drafting works which were prevalently theoretical; in spite of this, we must remember that the themes dealt with (although they are of philosophical or sociological nature) are always interpreted in the light of fundamental concepts of Uexküllian biology. The main results of the third period, which includes the majority of the author's work, are the following: the second edition of *Umwelt und Innenwelt der Tiere* (von Uexküll 1921), in which the theory of the *functional circle* (*Funktionskreis*) is seen for the first time; the article *Volk und Staat* (von Uexküll 1915); *Biologische Briefe an eine Dame* (von Uexküll 1919); the two editions of *Staatsbiologie* (von Uexküll 1920a, 1933) and the fundamental first edition of *Theoretische Biologie* (von Uexküll 1920b). The last three works all appear in 1920.

A Foray into the Worlds of Animals and Humans (von Uexküll 2010) deserves a separate discussion. Written in 1934, this work would enjoy wide circulation and be translated into the main European languages, testifying to the fervent activity of the *Institut für Umweltforschung* founded in Hamburg by Uexküll in 1927. In this work, alongside the theoretical arguments we also find the results of the empirical research which the foundation of the institute had made possible again. As we shall see, this work also testifies to the productive relationship between Uexküll and Lorenz, who contributed through the supplying of material taken from his research on corvids.

If we leave *A Foray into the Worlds of Animals and Humans*, however, the writings from the third period do not deal so much with the exposition of new empirical results as with the systematization of biological theory (a task which also includes the interpretation of new discoveries, which will be seen in *Theoretische Biologie*), the application of previously elaborated notions to issues belonging to other lines of enquiry (such as the theory of state) and, finally, the careful analysis of the philosophical implications of the Uexküllian biological conception. In terms of this last point, Uexküll's intention is to clarify the connections between his own *Lebensphilosophie* – founded partly on the *Umwelt* as a subjective production, and partly on the teleological nature of living things – and the two main points of reference of his philosophical formation: Kant and Plato. For example, in this regard we have *Die ewige Frage. Biologische Variationen über einen platonischen Dialog* [*The Eternal Question: Biological variations on a Platonic dialogue*] (von Uexküll and von Uexküll 1943; edition used in this work von Uexküll and von Uexküll 1944), which Uexküll wrote together with his son, Thure, in the months immediately prior to his death.

3.3 For a Teleological Biology: The Concept of Bauplan

We start our analysis of Uexküll's work beginning with the most important text of the first period – *Leitfaden in das Studium der experimentellen Biologie der Wassertiere* – adding other texts (articles and later works) where necessary in order to expand the area of study. In the first part of the text, which is of a theoretical nature, Uexküll oppose himself to the excessive metaphysical speculations of many authors of his time and emphasizes instead the placement of biology among the natural sciences. The second part is dedicated to the description of the methods of preservation, dissection, and empirical study of marine organisms. In terms of the scope of this work the first part is of greater importance; it not only includes certain fundamental suppositions which will stimulate the development of Uexküll's theoretical reflection, but also shows how they are always seen as answers to specific problems in real biological research.

The point of departure in *Leitfaden in das Studium der experimentellen Biologie der Wassertiere* is the distinction between physiology and biology. The first discipline, Uexküll writes, "arranges its empirical knowledge according to causality"; the second, instead, organizes the data "according to purposiveness" (von Uexküll 1905: v). Here we find clear references to the Kantian distinction between "strong" sciences, such as mathematics and physics, and "weak" sciences, such as biology. In Kant this difference depends on the judgments upon which the two types of sciences are based: mathematics and physics are founded upon determinant judgments, which are constitutive of their objects, while biology is born from reflective judgment, i.e. the institution (among already constituted objects) of links based on subjective sentiment. The judgment that links cause and effect in the epistemological framework of antecedent causality falls under determinant judgments; the judgment which establishes teleological relationships among different natural elements (or within nature as a whole) is a reflective judgment. In *Critique of the Power of Judgment* this is the fundamental reason for the lesser scientific nature given to biology in comparison with the other natural sciences.

It should be said, however, that Uexküll – emboldened by the empirical foundation that, thanks to Driesch, neovitalism believed to have given to the use of the category of finality in biology – seems to think that the Kantian problem of the lesser level of certainty in biology had been defused. In a later phase, that is in the second edition of *Theoretische Biologie*, Uexküll would state:

> Kant assigned the causality to constitutive activity of the intellect, while purposiveness to the regulative use of reason. This gives the impression that a plan can never be an integral part of the object, but a mere rule imagined by man, albeit necessary. Driesch addressed the issue in a detailed way, and proved that purpose is also to be included in the constitutive properties. And that settles the problem (von Uexküll 1928: 199).

In the introduction to *Leitfaden in das Studium der experimentellen Biologie der Wassertiere* Uexküll states that physiology and biology must be integrated together, because their use of different types of causes (far from being a limiting factor, or even a merely methodological one) allows for an in-depth inquiry into

their objects of study. It is surely true that, according to those physiologists who do not acknowledge finality (the "anti-biological trend"), "in physiology there are only two main problems: the use of matter and the use of force [by organisms]" (von Uexküll 1905: 4). For Uexküll, however, this adds up to the negation of biological specificity, that is to say the reduction of the science of living things to a specific sector of physics and chemistry; this makes it difficult to see the specific problems posed by the unique organization of physical and chemical elements in living organisms.

Fortunately, Uexküll observes,

> Biology could not be fully suppressed by physiological chemistry, because even the most hardened chemist has to admit that living is at the very least a machine, not just something mechanical; it is not just something that can be structured, but must have a teleological structure –, it is not just something organic, but an organism. Only this conviction, born from everyday experience, prevented physiological chemistry from being completely absorbed by organic chemistry (von Uexküll 1905: 4–5).[20]

Behind the expressions Uexküll uses, one can glimpse the controversies that divide the scientists and philosophers of the time into two opposing sides, the mechanists and the vitalists. In his later works Uexküll would have to take stances on this issue with specific references to his contemporary authors, Driesch above all (see for example von Uexküll 1909: 13), but this is not yet the case in *Leitfaden in das Studium der experimentellen Biologie der Wassertiere*. Here Uexküll limits himself to decisively rejecting the reduction of biology to a physicochemical formulation of physiology and to emphasizing the need for a unitary understanding of organisms. The specification which appears in the previous quote (the living thing is not just something mechanic, but "at the very least a machine") shows Uexküll's concern in safeguarding the structured wholeness (*Ganzheit*) which belongs to the living organism.

In *Leitfaden in das Studium der experimentellen Biologie der Wassertiere*, therefore, the holistic approach which Uexküll views as peculiar to biology is primarily based on the analogy between machine and organism: just as we cannot understand a machine through the chemical analysis of its parts, nor can we quantitatively measure the energy that it employs or discharges, but we must instead start from its building-plan. On the other hand, we cannot understand an organism if we do not follow its physicochemical processes back to the comprehensive plan and which regulate its formation and life cycle. But there are obvious differences between machines and organisms: with a distinctly Kantian tone, Uexküll states that the former are entities that are structured according to an external end, while the latter are internally purposive entities – entities "without end" in the sense of "being

[20]This conception of the tasks of biology can be found in an earlier article from 1903 on the building-plan of the sea worm *Sipunculus nudus*: "Biology is the doctrine of the organization of living things. Organization implies the connection between several elements according to a unitary plan. Therefore, the task of biology is to identify the building-plan and elements of this construction in any living being" (von Uexküll 1903: 269). This passage is cited in Cheung 2004: 139–167, 140–141).

an end in itself [*Selbstzweck*]".[21] However, in terms of the division of labor between physiology and biology the analogy to the machine proves to be quite fruitful.

In short, biology must occupy itself with the *unity* of the physiological processes with which the organism assimilates material and produces energy; its object, in other terms, is the overall plan that governs the search and assimilation of food, and thus the production of energy: "Finding sources of nourishment with the energy at hand and assimilating this nourishment to compensate for the energy consumed – these are the two main functions involved in the functioning of living beings" (von Uexküll 1905: 7). Further along in the – still very general – examination which Uexküll dedicates to the physiology of organisms, appear certain concepts that will play an important role in his later works: the distinction between receptor organs (*Rezeptoren*) and effector organs (*Effektoren*) and the notion of building-plan (*Bauplan*). As far as the first concept is concerned, it is the performance of the two principle functions of the organism – the finding and assimilating of food – which necessitates the presence of two distinct types of organs: receptor organs, which register the "actions" that the exterior world exercises over the organism, and effector organs, which allow the animal to react to stimuli (through movements or, less commonly, through secretions and other chemical processes).

Well-aware that the functioning of receptors and effectors could indeed be analyzed in physicochemical terms, and therefore seem exclusively pertinent to physiology, Uexküll clarifies that "without the use of force and matter, nothing happens in the world. But these problems do not come within the competency of biology. The *content* of every motion of force or matter does not interest biology, which only investigates the *form* that ties together these motions orderly" (von Uexküll 1905: 8). The aim of biology is thus "the relationship that holds together the performance of all organs, from the impact of stimuli by the receptors to the effectors' resulting answer" (von Uexküll 1905: 9). Uexküll calls this form or unifying relationship the building-plan of the animal.

For the importance it holds in the Uexküllian production, as well as in general for theoretical biology in the nineteenth and twentieth century,[22] it is opportune to make a more detailed analysis of the concept of building-plan and the problems (including

[21] von Uexküll 1905: 6. The statement of the autotelic characteristic of the living is accompanied in note by an unfortunately generic reference to Kant's *Critique of the Power of Judgment*. The idea of the "internal purposiveness" of the living thing sets out the distinction between purposiveness (*Zweckmäßigkeit*) and correspondence to a plan (*Planmässigkeit*), which is central in later works. Cf. *below*, 237; Kant 2000: 247; for the choice of "purposiveness" as translation of *Zweckmässigkeit*, see Kant 2000: xlviii.

[22] For a modern example, the use of the term *Bauplan* is also found in Gould, one of the main figures of the contemporary scientific critique of Darwinism – or better, of some of its features, such as gradualism and the overestimation of selection as a factor of change in genotypes (see Gould 2002: 251–341). But a concept similar to the building-plan was also referred to by Fodor when he speaks of the "return to the laws of form" as key to interpreting the evolutionary process which must be integrated with the natural selection perspective (see Fodor and Piattelli Palmarini 2010: 72–94).

the epistemological ones) that it brings. According to Uexküll, the building-plan "is sometimes directly accessible through experiments, sometimes must be gleaned deductively through strenuous reconstructions based on partial phenomena".[23] This methodological observation (which is not developed in *Leitfaden*) hints at a fundamental ambiguity: the ontological status of the *Bauplan* seems to alternate between a structure which actually exists in the organism and that of a model that is constructed by the observer and only present in his mind. In the end, Uexküll holds that it is the observer that, in order to understand the meaning, attempts to analyze the organism *as if* it were built by someone ("as if [. . .] one was holding a machine" (von Uexküll 1905: 10)).

Further, in *Leitfaden in das Studium der experimentellen Biologie der Wassertiere* another characterization of the concept of *Bauplan* is laid out, which Uexküll will later move to the background, but which still bears interest autonomously. In this phase of the Uexküllian reflection, the building-plan is intrinsically connected to the notion of reflex [*Reflex*], at least in animals. Reflex – or better the reflex arc [*Reflexbogen*] which starts from the receptor organ and arrives in the effector organ passing through sensory nerves, the nerve system, and motor nerves – is the primal element [*Urelement*] of the building-plan, to the point that Uexküll states that "Every animal is nothing but an ordered bunch of reflexes" (von Uexküll 1905: 10). In his later works, Uexküll will be much more cautious, and will no longer try to trace the vital organization of animals back to reflexes. However, it is still important to keep in mind that *Leitfaden in das Studium der experimentellen Biologie der Wassertiere* dates back to 1905, which is a period in which – in the wake of Pavlov's research on conditioned reflexes and Loeb's research on tropisms – the concept of reflex seems capable of scientifically explaining almost any phenomenon connected to physiology, movement, and animal behavior. In later years, Merleau-Ponty and the *Gestaltpsychologie* would criticize the overestimation of this concept (Merleau-Ponty 1967: 7–93; Koffka 1962: 50, 310–319) as well as Lorenz's research (see Lorenz's critique of Pavlov and Loeb in Lorenz 1977: 52, 240–241). Merleau-Ponty would concentrate on the idea that decomposition in reflexes would make animal action lose its overall meaning, while the *Gestaltpsychologie* would highlight the autonomy toward the external stimuli of the behavioral and instinctive sequences that animals possess.

Even when he wrote *Leitfaden in das Studium der experimentellen Biologie der Wassertiere*, Uexküll realized that the structure of the reflex arc could not justify all the phenomena which occur in living material.[24] As it is the fundamental

[23] von Uexküll 1905: 9. As we shall see in the part dedicated to the reception of Uexküll's ideas, a number of philosophers and scientists which were engaged with the concept of the building-plan understood it in the first sense, others (such as Merleau-Ponty) in the second.

[24] The position Uexküll takes towards the excessive use of Loeb's concept of tropism is much more direct: "Until recently, everything was broken up into tropisms. [. . .] Whether a fish swims upstream or downstream, that becomes a positive or negative reotropism. If a worm crawls for

element of the *Bauplan*, reflex can explain nutrition and preservative functions of an adult organism, but it cannot explain the physiological processes that guide the development of that organism in the embryonic phase. In embryogenesis,

> the functions that serve the organism's development do not find any purposeful structure beforehand, but they must build it themselves. The form shapes itself from the shapeless substratum of the living, as if the end goal was also the cause of the formation process. [We are faced with] the unfolding of a purposeful process without the restraint of a structure exerting its constrictive influence (von Uexküll 1905: 67).

Uexküll believes that embryonic development, growth and (in organisms with this capability) the regeneration of body parts are processes that do not only react to given conditions – according to the physiological schema of antecedent causality, which is typical of reflexes – but *they themselves establish little by little the conditions for achieving an ultimate end* (and thus clearly fall under the biological category of *final causality*).

Uexküll is and shall remain a staunch supporter of the explicative validity of final causality; in fact, if the role he reserves for final causes in *Leitfaden in das Studium der experimentellen Biologie der Wassertiere* is much smaller than in his later works, this is due to the popularity of the concept of reflex in the scientific field of his time. In line with the above-mentioned subdivision of tasks between physiology and biology, the reflex concept would be assigned the principal role in "vegetative and animal biology" (meaning the predominantly physiological sphere of nutrition and movement), while it is judged as insufficient in the "constitutive biology" (that is to say the phenomena of ontogenesis, growth, and regeneration, where the hypothesis of the action of final extra-mechanical causes remains inescapable) (von Uexküll 1905: 67).[25]

In *Leitfaden in das Studium der experimentellen Biologie der Wassertiere* the discussion of the reflex arc and the emphasizing of its importance as a fundamental unit in the building-plan offer Uexküll the opportunity to enunciate a methodological principle that he believes of the utmost importance. Starting from the consideration that the organs that make up the reflex arc must have a common element to allow for the passage of stimuli, Uexküll postulates the presence of a nervous fluid which is not immediately perceptible to our senses. This hypothesis, which had already been discussed in the eighteenth and nineteenth centuries (see for example De Ceglia

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shelter in a corner, we were faced with a positive goniotropism or criptotropism. If we consider the general outcome of this terminology, apart from the appeal of creating "new" Greek words, it has not led to much" (von Uexküll 1905: 95).

[25]The complete exclusion of final causes in biology only occurred with the discovery of genetic code, that is to say an antecedent cause – at the same time structural and functional – capable of determining and guiding ontogenetic processes and growth. This, however, does not mean that the overall dynamic of these processes, together with the cogent impressions of finality that they provoke in the human observer, were explained beyond doubt.

2009), is an invaluable theoretical instrument for Uexküll, which should not be set aside even in considering the obscurity and "vitalist mysticism" that it seems to bring with it:

> For a very long time, the expression *nervous fluid* [*Nervenfluidum*] did the job – good or bad, one has to say, as the nervous fluid soon turned out to be the carrier of a "life principle". Just like "life principle", an expression that seemed to describe an unclear feeling, rather than a clear thought, nervous fluid also got an almost mystical connotation. Afterwards came the time where it was thought possible in physics to replace the notion of fluid by the concept of movement. Under the influence of this line of thought, the former vision of nervous fluid was abandoned and replaced by the concept of excitability [*Erregung*]. This unfortunate substitution of a concrete concept with an absolutely void one led researchers to believe they had an object which did not possess any independent properties, but is just a function, which could easily become a mathematical formula (von Uexküll 1905: 10–11).

This resulted in physiology being concentrated almost exclusively on measuring the flows of excitation using galvanometers and electric meters, subsequently neglecting the overall form of reflex, meaning the fact that the building-plan comes to express itself in every single animal movement.

To put it in more general terms (and this is the methodological principle mentioned above) what Uexküll refuses to accept is the replacement of substantialist biology with functionalist biology – a strategy that is reminiscent of the critiques which Hume, and later Kant, employed against the notion of the substantial ego and supports instead a functionalist conception of the mind. In biology (this is Uexküll's conviction) this substitution would amount to the renunciation of every unifying instance and to the reduction of organisms into a chaotic whole of functions that are difficult to coordinate among one another. In his later works he attempts to theoretically base the teleological unity of the organism, connecting it for example to Driesch's notion of entelechy – who, incidentally, is only cited once and without great detail in *Leitfaden in das Studium der experimentellen Biologie der Wassertiere* (von Uexküll 1905: 68).

Among the ideas laid out in *Leitfaden in das Studium der experimentellen Biologie der Wassertiere*, the one that would garner the author most recognition is the detailed and comprehensive explanation of muscular mechanics, which occupies a large amount of the first part of the text, but for our purposes is of minor importance (see *above*, 20, n. 37). In terms of the beginnings of the Uexküllian biological theory, however, the features of the most interest found in this book concern the concept of *Bauplan*, its interpretation in terms of a theory of reflexes, and the affirmation of the theoretical validity of final causes (although this affirmation is compensated by the division of tasks between biology and physiology, which assigns to the latter a wide research field investigable through the category of mechanical causality).

In this phase Uexküll therefore accepts the validity of the mechanist approach for a large part of physiology and animal behavior, but at the same time emphasizes how they are processes that are interpretable only in a teleological viewpoint (or rather with "vitalist" theoretical instruments such as the *Bauplan*). This stance, however, does not imply what one might believe, that Uexküll sees the mechanist approach as

being reserved to empirical research and a finalistic approach to that of theoretical reflection: there are in fact entire sectors of empirical research (embryology first and foremost) in which the only means of explaining phenomena is to make use of teleological concepts, which therefore already assume a preliminary, orientative value in the experimental phases.

3.4 Towards the Umwelt: The Concept of Milieu

In the conclusion of our analysis of the first Uexküllian monograph we must underline the absence of one of the terms which would most contribute to Uexküll's fame: 'Umwelt', environment. The absence of this term does not, however, imply that a corresponding concept is completely missing, which can be found in a number of significant observations concerning the relationship between the world and the organism. Using a French term that was particularly common in sociology and natural sciences in Germany, Uexküll uses the word 'milieu' to mean the sphere of sensory and cognitive experience that an organism has of the world that surrounds it.

More specifically, Uexküll writes that milieu is "the part of the external world that affects animals". Uexküll continues by saying:

> The difficulty to establish which are the most effective stimuli for each animal is due to the fact that the outside world only makes us know our milieu. This situation is particularly noticeable regarding chemical stimuli, as we do not have any reagent whose sensitive quality could measure up against that of animals' receptors (von Uexküll 1905: 12).

What Uexküll underlines – and will continue to underline even after 'milieu' is replaced by 'Umwelt' – is the close correspondence between single animal species and the "sector" of the world that is accessible to them through sense organs. In other words, the notion of *species-specificity* of the environment is already present in *Leitfaden in das Studium der experimentellen Biologie der Wassertiere*.

The species-specificity of the animal milieu does not only depend on a different breadth of sensory fields but also includes the possibility of a perceptual organization that is radically different from our own. "We cannot deny" – writes Uexküll – "that [in biology] we may come across completely unknown stimuli, which we become aware of only through the animals' reactions" (von Uexküll 1905: 12). This type of sensory systems, for example, can be the echolocation of bats or the sensitivity to the earth's electromagnetic fields of certain species of migratory birds.

The concept of milieu is further developed in the conclusion of *Leitfaden in das Studium der experimentellen Biologie der Wassertiere*, significantly titled "Die Grundlage der Biologie" ["The foundations of biology"]:

> Experimental biology enlightens us as to how animals behave towards the objects in their milieu: animals only relate with objects that are able to send out stimuli that are strong enough to cross the threshold of the receptive organs. The stimulus must be converted into excitement, or else it stops existing for the animal (von Uexküll 1905: 124).

If lower animals (such as those with a radial structure) seem only to react to simple stimuli, Uexküll continues, those that have achieved a greater degree of complexity (a bi-lateral structure, a central nervous system) are capable of reacting to a combination of stimuli; in other words, a stimulus is accessible to their consciousness only when it is associated to another stimulus. Starting from this evolutionary level, one can say that the activity of perception seems to be based not only on the selection of stimuli but also on an unending activity of *synthesis*. Uexküll believes these cognitive operations are carried out in some "junctions" of the central nervous system which he defines *object nuclei* [*Gegenstandkerne*], and he outlines their function in the following terms.

> The final synthesis of all stimuli of an object takes place in the object's nucleus, after having been submitted to an in-depth analysis by the various receptors. The more object nuclei there are in a brain, the more objects it can distinguish (von Uexküll 1905: 126).[26]

As early as in *Leitfaden in das Studium der experimentellen Biologie der Wassertiere*, Uexküll is suggesting the idea, which he continued to support, of the complete correspondence between neural structures (here identified as object nuclei) and perceptual-cognitive constructions (the objects that are present in the species-specific milieu). According to him, it is not necessary that a subject grasp that an *object* is a unitary source of stimuli in order for the object nucleus to be activated; on both the perceptual plane and the behavioral one, it is enough that the animal subject receives the stimuli or combination of stimuli, without having to perceive the *substrate* of those stimuli in any way; it is possible for this substrate to not even appear at all, or to appear as a secondary production as regards to the reception of the stimuli.

This conception has relevant consequences on the definition of the tasks of experimental biology. According to Uexküll, experimental biology must understand, *for every species-specific milieu*, what can arise the animal's attention and provoke its reaction. To this end, the biologist has to use two methods: field observation of animal behavior, and the active administering of stimuli (or combinations of stimuli) to animal organisms. His work, in other words, is comparable to that of a musician searching for meaningful chords by combining the notes that spring forth from an instrument (on Uexküll's use of musical metaphors, and specifically that of the melody, *cf. below*, 213).

Leitfaden in das Studium der experimentellen Biologie der Wassertiere closes with an isolated observation dedicated to human beings. According to Uexküll, even the neural and perceptual structure of man follows the principles laid out above for animals. In other words, even for man it can be said that "all real objects in the

[26]There is a certain ambiguity in the term *Gegenstandkern*, or at least the potential for misunderstanding. At first glance it seems to indicate the outcome of the synthetic activities of the consciousness (i.e., the nucleus of the object as phenomenon); what Uexküll wants to indicate with it instead is the physical seat of the unifying operation of data concerning the object. In later works this term would no longer be used.

external world are functions of our brain" (von Uexküll 1905: 128). As we know, the credit for this fundamental intuition comes from Kant, whose terminology and ideas make up the theoretical background not only of this work from 1905 that we are examining but also the following and more mature versions of the Uexküllian theory of the Umwelt.

Behind the statement that "without receptive organs and without brain there is no knowledge for us humans" (von Uexküll 1905: 125) it is not difficult to recognize the Kantian idea that human awareness owes its contents (and its validity) on one hand to sensibility and on the other hand to the a priori forms of reason. But Uexküll's admission of gratitude to Kant takes a much more explicit form in the last passage of *Leitfaden in das Studium der experimentellen Biologie der Wassertiere*:

> Kant's three major critical works have been available for over one hundred years; they are not so much a philosophical system, as a scientific observation of the laws that govern the life of the human soul. It would be time to carry on here too through experiment (von Uexküll 1905: 130).[27]

As Mildenberger would state, this short, generic mention of all three critiques demonstrates that Uexküll has overcome his younger, mechanist reading of Kant (limited to the *Critique of Pure Reason*) for a wider use of Kantian ideas, which also include fundamental features of *Critique of the Power of Judgment* such as the overall purposiveness of nature and the teleological structure of the organism (Mildenberger 2007: 72). This is true, but we must also remember that the principal and most original link between Uexküllian theoretical biology and Kantian philosophy does not lie in the teleological approach – which Uexküll could have established in a myriad of other ways besides Kant, using references to Müller, von Baer, and Driesch for example – but in the extension to non-human subjects of the transcendental analysis of reason put forth in the first *Critique*, which is the true philosophical departure point of the Uexküllian *Umweltlehre.*

3.5 The Issue of Protoplasm

Let us move on to Uexküll's second monograph, *Umwelt und Innenwelt der Tiere*, and specifically to Uexküll's stance toward a scientific problem which in the second half of the nineteenth century and beginning of the twentieth held a central importance and represented one of the primary clashes between vitalists and mechanists: the issue of protoplasm. As in many other cases, numerous interpretative proposals were advanced upon the discovery of protoplasm (i.e. the proteinaceous, nitrogenous and semi-fluid substance that surrounds the cell

[27] Besides the general discussion of the teleology of nature, Uexküll's writings also reveal sporadic influences from Kant's *Critique of the Power of Judgment*; *cf.* for example the mention of beauty in von Uexküll 1913: 139: "Beauty is the feeling of purposiveness in the environment".

nucleus); these ideas were often rooted in the convictions that the individual scientist held concerning the general character of living things. Before we look at Uexküll's position, it is appropriate to reconstruct briefly the theoretical context of reference. The debate on the interpretation of cell components dates back to the first half of the nineteenth century; between 1838 and 1839 Schleiden and Schwann,[28] the founders of modern cytology, hypothesized that similar units constituted every living organism: cells. Their approach was predominantly mechanist, first due to the idea that the cell is a constitutive element of living material (a sort of biological atom), and second for their choice of the type of causality to be used in the study of living material: cells are posited as antecedent causes capable of explaining (in a non-teleological manner) the formation of tissue and organs.

Their theory, which is based on the idea that cell growth is a continuous process that is similar to the formation of a crystal, tends to give most importance to the nucleus and the membrane of the cell, relegating the other components to the background. As far as the function they assigned to protoplasm is concerned, the two scientists apply to this component – which they defined as amorphous substance or *blastema* – the function of supporting and feeding the structural components of the cell, primarily the nucleus, which remain responsible for the life that animates organic material. Their position, however, is mitigated by the hypothesis that within the amorphous substance itself there is an active *nisus formativus* which directs the formation of cellular components on one hand and on the other represents the superior principle that organizes the corporeal whole on a cellular level. Once again, if we enter in detail on the stance of single scientists we find a mixture of mechanism and vitalism (for an overview of this issue, cf. Dröscher 2002, and especially Geison 1969).

During the central decades of the nineteenth century, biologists were divided between those who, in the wake of Schleiden and Schwann, continued to see organic matter and thus life as the result of the formation of a nucleus within a membrane (like Remak[29] and Reichert[30]), and those who believed it was the consequence of the organizing properties of protoplasm. Among the second group, besides Haeckel

[28]Theodor Schwann (1810–1882). German physiologist, who possessed a solid philosophical education (his form of rationalism was heavily influenced by Descartes). Between 1829 and 1834 he was an assistant to Johannes Müller. However, in this time he did not adopt Müller's vitalist approach, opting instead for mechanism. Together with Schleiden (*cf. above*, 24, n. 8) he dedicated himself to the study of cells and to the formulation of a comprehensive and unitary cytological theory. In 1939, perhaps due to the influence of his brother (the theologian Peter Schwann), Theodor left his scientific career and began studies into religion and spirituality, thus abandoning his early rationalism.

[29]Robert Remak (1815–1865). Jewish-German neurologist and zoologist, he studied nerve anatomy and the processes of cellular division.

[30]Karl Reichert (1811–1883). German physician and student of Müller, he primarily focused on histology and the evolutionary history of the brain.

and Kühne, we find Nägeli,[31] Mohl,[32] Schultze,[33] Cohn[34] and Brücke.[35] The second position quickly became predominant.

In reference to this Geison writes:

> [In the 1860s,] the publication of full-length books with the word "protoplasm" in their titles is indicative of an escalating interest. The view was rapidly gaining ground that the basic condition essential for life resided in a substance called protoplasm, and that the importance formerly attached to the cell wall should be looked upon as a quaint anachronism [...] By 1869 Haeckel was able to report that the new point of view was "almost universally recognized". [...] The "protoplasm theory" had won a decisive and permanent victory (Geison 1969: 278; for Geison's reference to Haeckel *cf.* Haeckel 1869).

Such a victory should not, however, be read as the victory of vitalism; the recognition of the central role of protoplasm in shaping living material did not resolve the problem of the nature of life. Protoplasm can be seen in two ways: either as the autonomous matrix of cellular components – and in this case it is necessary to concede that once matter has reached an adequate level of complexity it is sufficient to create life; or as a substrate assigned with the reception of the effects of immaterial vital forces capable of transmitting life.

The possibility for this dual interpretation clearly emerges from the controversy which, in the 1960s and 1970s of the nineteenth century, pit Thomas Huxley[36] against Lionel Beale.[37] The crux of the debate is Huxley's claim that protoplasm is the "physical basis of life", made in a famous conference held in 1868 (Huxley 1869: 129). Primarily known as a staunch materialist and supporter of Darwinism, Huxley sees the possibility to reaffirm his own conception of life in the theory of protoplasm. First of all, to him this theory seems to be the confirmation of the phylogenetic unity of all forms of life: the fact that all organisms are composed of protoplasmic units equipped with a nucleus is evidence of their common descent.

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[31]Carl Wilhelm von Nägeli (1817–1891). Swiss botanist, in 1844 together with Schleiden he founded the *Zeitschrift für wissenschaftliche Botanik*. In cytology he is one of the main supporters of the micelle theory.

[32]Hugo von Mohl (1805–1872). German botanist, he studied the composition of cells and plant tissue. Most likely he is due credit for the coining of the term protoplasm, which he introduced into scientific debate in 1846.

[33]Max Johann Schultze (1825–1874). German anatomist and cytologist, one of the first to give a general definition to cells as a mass of protoplasm equipped with a nucleus.

[34]Ferdinand Cohn (1828–1898). Jewish-German biologist and botanist.

[35]Ernst Wilhelm von Brücke (1819–1892). German physician: despite being a student of Müller, he supported a form of hard mechanism.

[36]Thomas Henry Huxley (1825–1895). English zoologist and paleontologist, his field of study ranged from marine invertebrates to vertebrate fossils. He is known mostly for his friendship with Darwin and for his scientific and journalistic commitment in support of the Darwinian idea of evolution by natural selection.

[37]Lionel Beale (1828–1906). English microscopist and physiologist, besides his staunch vitalism and the heated disputes with Darwin and Huxley he is known for having published numerous manuals on the use of the microscope.

Second of all, the protoplasm theory provides him with the possibility to reaffirm his own materialistic conception of life: protoplasm – a proteinaceous composite formed by four elements (carbon, hydrogen, oxygen, and nitrogen) – "is built up of ordinary matter and again resolved into ordinary matter when its work is done" (Huxley 1869: 136). In positing the idea that "vital forces are molecular forces", Huxley claims that all properties and faculties of protoplasm result from the disposition of elements that compose it, without having any need to look for extra-material vital forces. Huxley's intention, in short, is to present the great popularity of the protoplasm theory as a victory of mechanism over vitalism (Huxley 1853: 221).

For the next two decades, Huxley's stance was the center of debate. In Germany it obtained unconditional approval from Haeckel, who stated that "the protoplasm theory [is] one of the first and most important foundations of a truly monistic, i.e., mechano-causal knowledge of organic nature" (Haeckel 1869: 229). Regardless, there was no lack of opponents, some of which (integrating Darwinism and materialism) shed light on the teleological-religious consequences of Huxley's conception of living matter, while others moved from considerations of a more directly biological nature and attempted to propose a non-mechanist reading of protoplasm.

In this last group, the physiologist Beale would assume a particular role, almost that of spokesperson for the anti-mechanist reaction. His critiques of Huxley and the mechanist interpretation of protoplasm, which had already partially been formulated prior, were brought together and systematized in *Protoplasm; or Life, Force, and Matter*, an 1870 text that served as a response to Huxley's conference in 1868 (Beale 1870). The central core of Beale's conception lay in the distinction between germinal matter and formed matter: within every cell, in other words, there is a fertile and productive part, the germinal matter or protoplasm, and another part that is fixed and unmodifiable, the formed matter (which composes corporal tissues: nerves, muscles, bones, etc.). Germinal matter is the source of growth, modification and the regeneration of organisms; it is devoid of structure as it is endowed with an active and spontaneous capacity of movement and modification. This is evident in single-cell organisms such as the amoeba, in which germinal matter prevails and the structural part is almost entirely absent. The particular qualities of germinal matter derive from a vital force that is not identifiable through experiment but, Beale claims, would be unreasonable to ignore.

The notoriety and effectiveness of Beale's work can be traced back to multiple factors. On one side, he was capable of grasping real weaknesses in Huxley's conception – which, for example, does not explain why protoplasm, that specific composition of chemical elements, makes properties emerge that are inexistent in the objects of study of physics and inorganic chemistry. On the other side, he provides vitalists with the possibility to hold their position (specifically their vision of life as an outcome of agents that work on matter, and sometimes *against* matter) without entrenching themselves in an antiquated refusal of new discoveries in the field of cytology. Beale's fundamental distinction between germinal matter and formed matter is usable in the empirical, causal-analytic study of the cell's structural components, and at the same time allows to maintain the important role of immaterial factors in the origin and formation of organic structures.

Despite revealing deep connections with this part of the debate on the nature of protoplasm, the immediate background of Uexküll's observations are made up by researches on regeneration and cellular regulation that, at the end of the nineteenth and the beginning of the twentieth century were carried out by Kühne, Roux, Driesch and Spemann in Heidelberg and also at the Zoological Station in Naples.[38] We must remember that until 1900 Uexküll worked with Kühne, who was one of the main supporters of the preminence of protoplasm over other cellular components (the nucleus and membrane) (Kühne 1864), and who in the late 1800s closely followed Driesch's experiments on embryology, which seemed to attest to an autonomous normative and organizing capacity in embryonal cells (a capacity that was potentially traceable to the intrinsic qualities of protoplasm) (Cheung 2004: 144).

Uexküll enters the debate with an explicitly anti-mechanist slant, assuming a position quite reminiscent to Beale. Consistent with his training as a zoologist, rather than dedicate himself to the study of cells extracted from the tissue of multi-celled organisms, Uexküll turns to the study of amoebae. Due to their lack of fixed organs, these single-cell organisms had already appeared to Beale as particularly clear examples of the vital properties of protoplasm. In amoebae, Uexküll states, protoplasm is able to modify itself with such a spontaneity – and, more importantly, in such a teleological manner – to create new cellular configurations in response to changing environmental conditions.

One of the texts that best explains the Uexküllian conception of protoplasm is the first section of his 1910 article *Die Umwelt*, entitled "The problem of protoplasm" (von Uexküll 1910).[39] Readdressing the question of whether it is legitimate and scientifically productive to put living organisms and machines on the same level (as mechanists often do), Uexküll proposes the following difficulty: if on hand organisms can almost always be analyzed successfully using the analogy of the machine, on the other hand, they can also present three "supermechanic properties [*übermaschinelle Eigenschaften*]" which are not in the least bit consequent with the explicative model of the machine (von Uexküll 1910: 640). These properties or faculties, which testify to the primal capacity of auto-organization of living things, are *morphogenesis, regeneration* of tissue and *regulation* (incidentally, the similarity of these characteristics to the properties that Beale assigns to germinal matter is evident).

The first faculty manifests itself within embryogenesis, meaning all of the processes with which cells of a fertilized ovule differentiate, assemble into organs, and acquire form and structure; morphogenesis is thus the gradual development

[38]For an in-depth reconstruction of the different phases of Uexküll's thought on the issue of protoplasm, including his review of the references of the cited authors, see Cheung 2004: 146, 148–155.

[39]Overall the article, which is dedicated to the concept of environment, falls into the second period of Uexküll's production both chronologically and thematically; it will thus be analyzed in detail in the following chapter. For its relevance in terms of the debate on vitalism, however, some of its content will be discussed here.

of the structure of the adult organism starting from its initial cell. In terms of the regeneration of tissue, it is a phenomenon that, from Trembley on, had assumed a paradigmatic value and seemed irreducible to exclusively mechanic dynamics. In the majority of cases, Uexküll claims, the action of supermechanic properties is concentrated in the initial phase of the organism's life, and this is the reason why mechanism possesses its most serious limitations in embryology. As regards the functioning of the adult organism, however, the analogy of the machine is *almost always* entirely legitimate; even the concept of *Bauplan* was born to be able to interpret the animal "as if" it were designed by a rational being and on mechanical bases.

There are, however, certain monocellular organisms, like amoeba, in which even the functioning of the adult organism is explainable only in reference to supermechanic properties, specifically the faculty of *regulation*. In the theoretical biology of the time, regulation meant the internal coordination of the physiological processes that are carried out in an organism; this phenomenon, on which Roux in particular would draw attention, seems explicable only by postulating in the organism a central force that acts in a teleological and harmonizing sense. In reference to amoebae Uexküll makes a distinction between the normal *physiological regulation*, which allows organisms to adapt their own intra-organic conditions (temperature, acidity, etc.) to environmental conditions, and a specific type of regulation, the *supermechanic regulation*, which makes modification of the *Bauplan* possible even in the adult stage of the life cycle.

It is this second type of regulation that makes amoebae and ciliates unique in the kingdom of living things. These organisms do not, in fact, possess a fixed organization nor a permanent structure, but rather create the organs they need on a case-by-case basis. Here we are dealing with pseudopods, temporary structures that have variable shapes and dimensions whose function can vary from the assumption of nourishment, to movement, to escape. As far as ciliates are concerned, in the second edition of *Theoretische Biologie* Uexküll writes: "The inside of these animals still consists of fluid protoplasm, and [when they feed] it surrounds every bite by a bubble that will in turn become mouth, stomach, intestine, and finally anus" (von Uexküll 1928: 98).

In the first edition of *Umwelt und Innenwelt der Tiere* the special vital organization of the amoeba is described in the following terms:

> Naturally, in animals whose main activity consists of creating momentary organs and then destroying them again, during which the building-plan is constantly changing, the supermechanic regulation clearly steps in the foreground, whereas in higher animals, equipped with more permanent organs, [...] mechanic regulation stands out. And if we consider, perfectly rightly, the supermechanic regulation as a specific property of life, we must say: *an amoeba is less of a machine than a horse* (von Uexküll 1909: 26).[40]

[40]In amoebas, therefore, we find confirmation of the general law of the development of organisms which Uexküll summarizes thusly: "The framework [*Gefüge*] inhibits the building of frameworks [*Gefügebildung*]" (von Uexküll 1922: 146–147; cited in Cheung 2004: 147). If a definitive structure is missing, therefore, the process of formation of temporary structures does not undergo

The comparison between two animal species that are so far apart is intended to underline the extraordinary plasticity of the amoeba, because it is made up almost exclusively of protoplasm. Uexküll believes protoplasm is the location of life and defines it as a mixture of substances capable of guaranteeing a state of "continuous regeneration" (von Uexküll 1927: 19).

According to Uexküll a mechanist-formulated biology cannot comprehend the nature of protoplasm nor the formation process of temporary organs. Ultimately, in their final essence protoplasm and pseudopods are destined to remain "a wonder [*ein Wunder*]" (von Uexküll 1909: 28) for all manners of scientists. What can be understood of them, however, is firstly their affinity with the above mentioned supermechanic properties, and secondly the fact that in all of these cases a type of causality is active that is different from what is commonly allowed for by science:

> Only mechanical units are comprehensible [to science], in which, like in machines, all the parts are mutually dependent at the same time in space. It does not seem to make sense that some factors also influence each other in time. To our intellect, time only allows for the effect of the preceding on the following and not the other way round. If such a thing happened, i.e. if the following influenced the preceding, we would readily speak of a miracle. Even so that is exactly what happens in protoplasm. It is not the current structure, but the one to come, that determines the protoplasm's behavior in every single case of structure-creating. [. . .] This fact is a miracle, not because of its lawlessness, but because it proves the action of incomprehensible laws (von Uexküll 1909: 28–29).[41]

Among the authors that most contributed to shedding light on the presence of these laws Uexküll again recalls Driesch and his theory of vital force or entelechy. Despite supporting the vitalist front, however, Uexküll treads very lightly. Supermechanic qualities, specifically the ability of protoplasm to modify in some cases even the *Bauplan* of the adult organism, have a marginal importance in the field of zoology. With the exception of a few single-cell organisms, the physiology, behavior, and relation to the environment of organisms can and must be interpreted with exclusive reference to structural factors and antecedent causes, that is to say without referencing to supermechanic elements:

> In the operating of already built structures, protoplasm does not step in but exceptionally. That is why the course of the normal life functions of animals, being based on the performances of the structures, is to be considered as purely mechanical. [. . .] And there is

interruptions. With a slight variation – the term *Struktur* in the place of *Gefüge* – the same concept is expressed in von Uexküll 1909: 13.

[41]The attention Uexküll pays to the world of single-cell organisms is already seen in *Leitfaden in das Studium der experimentellen Biologie der Wassertiere*, where the difficulty in interpreting the functioning of protozoa in terms of the reflex theory are presented: "As protozoi are made of one cell only, they cannot possess organized reflex arcs" (von Uexküll 1905: 68). Therefore, it is quite consistent that in the first edition of *Umwelt und Innenwelt der Tiere* the problem of protoplasm is dealt with not by turning to the mechanics of reflexes, but by calling on teleological and unifying flows.

> no reason for the fear of some excellent researchers that the current neovitalism [Driesch's] will set a limit for their researches, aimed at the identification of the [antecedent] causal connections (von Uexküll 1909: 31).[42]

Uexküll's position in the debate on the nature of protoplasm, which in his later works would not change substantially (see von Uexküll 1928: 97–98), attempts to reconcile a feeling about nature that is profoundly steeped in vitalism – visible in the claim concerning the ultimate unknowability of protoplasm and in the stress on its harmonizing and teleological functions – with the advantages brought by causal analysis and the machine analogy.

The complexity of the Uexküllian conception of protoplasm would appear again in connection with the principal object of our interests, his environmental theory. If on one hand the transcendental constitution of the environment depends on the building-plan of the organism (represented on a cellular level by protoplasm), on the other hand, however, *as the final product* of the animal subject the species-specific environment is a fixed structure, and so hinders the direct activity of the protoplasm. As we shall see when discussing *A Foray into the Worlds of Animals and Humans*, organisms in which direct protoplasmic activity is higher will be those with the simpler environments, in which isolated and punctual stimuli prevail and there is a lack of superior organization such as space, time, and the object unification of stimuli (as for the paramecium, a ciliate whose environment foresees only one single stimulus; *cf.* von Uexküll 1910: 80–81 and *below*, 140).

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[42]Clearly, this does not exclude that the enquiry could regard the correspondence with a plan of the studied structures, their overall finality; according to Uexküll, tough, that finality should be considered as a given, without searching which forces or factors ultimately established them.

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Chapter 4
The Subjective World of the Umwelt

Abstract The chapter introduces the most important concept of Uexküll's thought: the idea of the environment (Umwelt) as subjective world. Through the analysis of the first edition of *Umwelt und Innenwelt der Tiere* and of the article *Die Umwelt*, the chapter shows how (according to Uexküll) each animal species constitutes around itself a different subjective world, which (with an increasing order of complexity) can be composed of isolated stimuli, combinations and synthesis of stimuli, unitary objects, the functions of the objects, etcetera. The chapter also outlines two central themes of Uexküll's theory, which will be examined later: the presence, in each Umwelt, of a felt and an unfelt part, and the cognitive relation between the Umwelt and the external reality.

Keywords Umwelt • Subject • Stimuli • Synthesis of objects • Human observer • Felt/unfelt environment

4.1 The Origin of the Concept

The second phase in which we have divided the work of Uexküll, from 1905 to 1918, bears witness to the development of the concept of environment (Umwelt). This concept would prove to be enormously fruitful and significant, not only within Uexküll's conceptions but also in the much larger context of biology, philosophy and the humanities of the twentieth century. Umwelt is usually translated as "environment", though literature in biology and philosophy often use the term "environment-world", which has the advantage of preserving the semantic richness of the German: *Um-Welt* is literally the world around, the world in which the subject is placed in immediately and without reflection. The expression environment-world, which will be adopted in this work when appropriate, also has the advantage of clearly showing its contraposition to the concept "world" (*Welt*) understood as a further symbolic elaboration of the environment which is carried out by human beings (setting aside for now the problem of whether this elaboration occurs at a cognitive, linguistic, existential or ontological level).

The texts which best allow us to follow the evolution of the concept of environment in this second phase of Uexküll's work are the first edition of *Umwelt und Innenwelt der Tiere* and the article *Die Umwelt*. The first text provides

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ample illustration of the usefulness of the concept of Umwelt by means of its application to the study of a number of particularly significant animals, while the second is dedicated to the philosophical investigation of the new concept. It seems that Uexküll – after having understood how prolific this concept was, which had spontaneously emerged from the marriage of empirical research and Kantian philosophy – first dedicated himself to verifying its scientific richness and only later investigated the theoretical implications and the genealogical links with other philosophical ideas (as we will see, first and foremost with the Kantian philosophy).

In the preface to the first edition of *Umwelt und Innenwelt der Tiere*, Uexküll posits that the animal and its environment constitute a functional unity determined by the building-plan. This unit comprises features that are anatomical, physiological and cognitive as well; and the latter are inherent to the formation of the inner world (*Innenwelt*) of the animal. In determining the concept of the inner world it is necessary to make a clarification: at first glance this may seem to be a clearly psychological notion, while in reality it is a physiological concept.[1] It is, therefore, completely consistent that, in dealing with cognitive features, Uexküll never turns to the theoretical instruments of animal psychology of his time; in fact, he explicitly distances himself from them.

The position of the biologist in regards to animal psychology remains unchanged over the course of his scientific work: early on in his 1900 article *Über die Stellung der vergleichenden Physiologie zur Hypothese der Tierseele* [*The Place of Comparative Physiology toward the Hypothesis of Animal Soul*] (von Uexküll 1900) Uexküll holds that in studying animal behavior it is entirely misleading to use terms taken from human psychology such as "awareness", "consciousness", "memory", "perception" etc. (as scholars such as Wasmann[2] and Romanes[3] did). According to Uexküll, the path to take (that of comparative physiology) rather consisted on one hand in the observation and physiological description of the processes occurring in the central nervous system, without indulging in speculation on their eventual representative contents, and on the other hand in the transcendental investigation into the ways of organization of the stimuli present in the mind of the animal.[4] Thus, the analysis of the environment, while necessarily taking into

[1]Which would be well-understood by Plessner, who in one citation from the second edition of *Umwelt und Innenwelt der Tiere* would make a significant contribution in brackets: "Functions simply make a chain that goes through the inner world (i.e. the body!)" (Plessner 1975: 249; Plessner quotes from von Uexküll 1921: 177).

[2]Erich Wasmann (1859–1931). Austrian entomologist, his field of study consisted in the behavior of ants and termites; in *Über die Stellung der vergleichenden Physiologie zur Hypothese der Tierseele* Uexküll directly objects to one of Wasmann's contributions (von Uexküll 1900; Wasmann 1900).

[3]Georges John Romanes (1848–1894). Canadian physiologist and biologist close to Darwin, in his 1882 book *Animal Intelligence* – which, despite a certain lack of scientific rigor, was widely circulating and influenced later ethology – attempted to demonstrate the presence of intelligence in a large number of animal behaviors (Romanes 1882).

[4]Uexküll does not go so far as to affirm that there is no relation between the physiological processes (those cerebral most importantly) and the emergence of quality and psychic phenomena; a relation

account perceptual aspects and being centered on the role of the subject, must entirely exclude speculation on the level of consciousness of those perceptions as well as other psychological issues linked to the *contents* of consciousness. As the author underlines, the relation between *Umweltforschung* and animal psychology is the same that runs through Kantian philosophy and human psychology: in both disciplines the subject is the focus, but the specific field of the former is the ordering and founding function that the subject has in dealing with the world (and which is inherent in the same concept of transcendental structure) (von Uexküll 1900: 502, 1902: 215–217).

Before more in-depth exploration of the theoretical links between the building-plan of the organism and the formation of an environment-world around the animal subject, it is necessary to make a further critical premise. As we have seen, Uexküll maintains that the building-plan does not coincide with the immaterial formative force which, in a typically vitalistic manner, guides the formation of the organism. The *Bauplan* is "merely a draft made by us [observers]", a "space schema" (von Uexküll 1909: 12) with which, on a subjective level, we can know the effects on matter of the formative force itself, its ways of expression.

For Uexküll, therefore, the building-plan

> has nothing to do with the actual natural factor [*der wirkliche Naturfaktor*] which forces physical-chemical processes to take a certain course. [This] is only the way we can know the effects of the said natural factor. In itself, the natural factor is completely unknown to us. Driesch, referring to Aristotle, calls it "entelechy", Karl Ernst von Baer calls it "goal-directedness" [*Zielstrebigkeit*] (von Uexküll 1909: 13).

But if this is generally true – that the building-plan is the mere phenomenal form of a teleological "natural factor" which in itself is unknowable – in his concrete scientific research Uexküll often uses the term *Bauplan* to refer to the structure and the organization of the animal itself, thus leaving out the question of its effective substrate (which is called upon only in the presence of super-mechanical phenomena which would be difficult to explain otherwise). Therefore, in our presentation of Uexküllian theoretical biology to follow we, too, will use the term building-plan to mean *the overall organization of the environment-animal system* – hereby endowing such an entity with an ontological status and not merely a gnoseological or epistemological one.

From the first pages of the first edition of *Umwelt und Innenwelt der Tiere*, a precise characteristic is clearly highlighted in the species-specific building-plans: fixity. This characteristic plays a very controversial role in relation to the Darwinian idea of the evolution of species toward ever-improving adaptation in response to external conditions. According to Uexküll, in other words, the environment-organism functional unit is for all species a definitive and complete configuration.

In the second edition of *Umwelt und Innenwelt der Tiere* Uexküll will reformulate this concept in the following manner: "The single animal is not more or less well

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exists, "even if it is not of a causal nature" (von Uexküll 1900: 500). On Uexküll's stance on animal psychology, *cf*. Bassanese 2004: 60.

adapted to its environment; on the contrary, all animals are inserted [*eingepasst*] into their environments with equal perfection" (von Uexküll 1921: 4). Here we find the appearance of one of the key concepts with which Uexküll attempts to comprehend the relation between organism and environment, that of *Einpassung*. Coined with explicit reference to the Darwinian notion of *Anpassung* (adaptation), the term *Einpassung* can be translated as *adaptive insertion*; the prefix *ein-* evokes an idea of the extremely close integration between the animal and its environment, the existence of a reciprocal dependence that does not acknowledge gradations. It is important to underline the finalistic character of such a relation: the configuration in which organism and environment are integrated is teleologically directed by the building-plan, which thus ends up governing the entire ecology of the species. The latter, therefore, cannot be understood unless we reason "as if" it had been planned beforehand in order to function in the best possible way; in fact, for Uexküll it is just so, even if we do not know nor can we ever know this programming factor (the *Naturfaktor*).

The idea that species are unchangeable entities, each occupying a pre-established environment-niche, is further clarified in *Die Umwelt*. In attempting to shed light on all of the theoretical implications of the concept of environment, Uexküll writes:

> There is no such thing as the adaptation of animals to a world common [to the various species]; similarly, there is no generic struggle for existence. Every animal has its own environment and its own existence. Adaptation to a foreign environment and struggle for an external life are clearly nonsense (von Uexküll 1910a: 640).

The fixity of species, in other words, brings with it the fixity of environments. In the theoretical biology of Uexküll, in which every species constitutes a closed, functional unit with its environment, the very concept of interspecific competition loses meaning. Because the building-plan regulates all species-specific relations with the external world, species could only compete for possible new environmental relationships (for example new resources or new prey). This, however, would presuppose a variation in the perceptive endowment of organisms which could make environmental novelties accessible to them. For Uexküll this cannot be, because the regulating influx carried out by the *Bauplan* in the embryogenetic stage is insurmountable. Further, on the level of perception, the building-plan only allows very precise elements from the external reality to pass, which the organism then integrates into its ecology until it forms an indissoluble unit with them (von Uexküll 1921: 104).

On the basis of these observations it is not surprising that, starting from writings from 1909 to 1910, expressions such as *struggle for life* [*Kampf ums Leben*] and *struggle for existence* [*Kampf ums Dasein*] (which in *Leitfaden in das Studium der experimentellen Biologie der Wassertiere* appear with a neutral meaning)[5] are used by Uexküll only to critique and refute. At the same time, his attacks on Darwinists

[5] So writes Uexküll: "The harder the struggle for survival, the more varied the tasks assigned to the motor mechanism" (von Uexküll 1905: 7); "obviously, the organisms equipped with such receptors cannot not benefit greatly from them in the struggle for survival" (von Uexküll 1905: 7).

become ever more direct and intense. Any trace of the initial enthusiasm Uexküll once felt as a university student at the discovery of Darwin's theory of natural selection gradually disappears; and it is the definition of the concept of *Einpassung* that marks a central stage in this process.

Leaving behind the issue of fixity of species and environments for the time being, let us return to the first edition of *Umwelt und Innenwelt der Tiere*. One of the virtues of this monograph is that the theoretical description of the concept of environment is enriched and made concrete by an accurate analysis of the environments of the marine animals Uexküll studied during his stay at the Zoological Station in Naples (primarily jellyfish, sea urchins and octopus). This work is a comparative study directed at understanding how, through the influence of the species-specific *Baupläne*, the environments of different species are established.

> Only a superficial look can lead to think sea animals live in a uniform world common to all. A closer look shows us how each and every one of these hundreds of different life forms possesses its own specific environment, which is in a relation of mutual determination with the animal's building-plan. [. . .] Around the animal expands itself a new world, completely different from ours, its Umwelt (von Uexküll 1909: 5, 6; italics by Uexküll).[6]

Besides the establishment of the species-specific environment, the building-plan – due to the natural factor hidden behind it, whose harmonizing influence extends well beyond the single species – also regulates the relationships among the different environments:

> It should be no surprise that the environment of an animal also includes other living beings. A relationship of mutual determination also establishes itself between the animals themselves, which gives way to the significant phenomenon that the hunter corresponds to the hunted as much as the hunted corresponds to the hunter. For this reason, not only is the parasite *pre-adapted* [*eingepasst*] to its host, but so is the host to the parasite (von Uexküll 1909: 5–6).

Here we find one of the most significant steps forward in the Uexküllian comprehension of the environment: much more than just a mere combination of physical, atmospheric and climatic conditions, the environment is *the intertwining of vital relations with other living beings*. This is why Uexküll no longer uses the term 'milieu' (which mainly refers to the physical context in which a species lives) to express this particular nature of the environment. Instead, he adopts the term 'Umwelt', giving rise to a current of environmental and ecological thinking that has continued until modern times.[7]

[6] In *Die Umwelt* Uexküll draws an explicit methodological indication: "We have absolutely no right to affirm that the world of *our* sense organs is the animals' world. On the contrary, every animal lives in a world specific to it, different from that of its neighbours. We must, therefore, speak of countless "environments", amongst which the world surrounding us is only an isolated case, which should not be considered normative" (von Uexküll 1910a: 639; italics by Uexküll).

[7] On the terminological and conceptual passage from milieu to Umwelt in philosophical and scientific terminology, as well as Uexküll's role in this, see Canguilhem 2008: 98–121.

Thus far it should be clear that the main difficulty in understanding the Uexküllian concept of environment consists in combining the descriptive aims and the great attention given to details of animal environments (present in works such as *Umwelt und Innenwelt der Tiere* and *A Foray into the Worlds of Animals and Humans,* which are significant precursors to ethology) with the awareness that the Umwelt is the product of a transcendental activity on the part of the animal subject – and this also holds true when other subjects take part in the same Umwelt. As we shall see, if Uexküll's "ethological" inspiration makes his works accessible to non-specialists, the second aspect makes it vulnerable to numerous critiques and objections.

But let us return to the 1909–1910 texts and continue our analysis, which reveal the presence of methodological observations of great importance. According to Uexküll, when faced with the challenge of understanding animal environments, especially the most elementary, the researcher must adopt a research method laid out in two phases. First, for every species studied, he must identify the objects which have a role in its environment-world; in order to do so he must start with the environment that is most accessible to man (a large part of which overlaps with animal environments – a point we will look into in greater detail) and proceed with the elimination, the "canceling" of all objects and object properties that have no relevance for the species being studied. Second, he must identify the sensorial stimuli that, after having originated from the remaining significant objects, reach the nervous system of the animal being studied. Upon completion of these two passages, the map of that species-specific environment should emerge.

The biologist, in other words, must ask himself the following questions:

> "Which parts of the world are accessible to animals?" (von Uexküll 1910a: 638)

> "Which qualities of the objects surrounding us have an influence on the meaning organs of single animal species?"; "What remains, for an earthworm for example, of the world surrounding us?" *That rest of the world constitutes its environment* (von Uexküll 1910a: 641; italics by Uexküll).

If an animal's environment is made up by the entirety of relevant objects (or, for inferior animals, by the entirety of relevant object properties), the ensemble of stimulations that it is capable of elaborating on the nervous system level constitutes its *inner world* (*Innenwelt*). Far from being a psychological notion, this inner world is a physiological concept: the inner world is a network of nerve connections whose articulation attempts to reconstruct, in the organism, the object situation of the external world (which, however, will in itself always remain inaccessible to the organism). Just as the Umwelt, the inner world will be as limited and simple as the corporeal structure and the ecology of the species in question are. Moreover, and always in analogy with the Umwelt, not all of the inner world will be perceived: many of the stimulations which pass through the "nerve pathways" will be processed without the organism being aware, or rather without the organism reperceiving them.

In the first edition of *Umwelt und Innenwelt der Tiere*, the first animals analyzed according to these methodological principles are one-cell organisms such as amoeba and paramecium. Uexküll holds that in the ecology of those organisms, which is both "prodigious" (as it is subjected to the direct influx of protoplasm, as we saw

in the previous chapter) as well as elementary, it is not possible to hypothesize the presence of objects understood as "syntheses of stimuli". In their environment, one has to limit himself to the identification of individual stimuli that act on the organism or provoke a reaction (usually a reaction of flight).

The key example of this is found in the paramecium: "The paramecium's environment is limited to two things: liquid with stimulus and liquid without stimulus, the stimulus being either chemical or mechanical [. . .]. It is thus possible to speak of an environment with only one type of stimulus" (von Uexküll 1909: 47).[8] Besides summarily delineating one of the most elementary environments that can be imagined, the above mentioned quote permits us to bring out the most important trait in the Uexküllian idea of the environment (which will be explored in greater depth later). Uexküll holds that the stimuli that come from the outside are themselves undifferentiated; the qualitative distinction in optical, tactile, olfactory etc. stimuli is a product of the nervous system, and it is an operation that not all organisms are capable of carrying out. To say that the Umwelt of the paramecium is "an environment with only one type of stimulus" does not mean that there is a sole, well-defined stimulus (for example only a chemical one), but that the inner world of the paramecium is not able to make any qualitative distinction among nerve stimulations – and therefore its experience is likely unimaginable for the human subject, who is unable to abolish such distinctions.

We find a higher level of physiological, environmental and even behavioral complexity in the sea urchin, an animal to which Uexküll dedicated a great deal of time as far back as his early studies. In *Leitfaden in das Studium der experimentellen Biologie der Wassertiere*, however, research into the sea urchin did not yield significant results in terms of the concept of environment but instead remained confined to the field of a physiological theory of reflexes. Uexküll limited himself to showing that, contrary to what occurs in superior animals, the reactions of sea urchins and other radially symmetric organisms are not centrally organized. The analysis of the *Bauplan* of such animals reveals that within them "the single organs along with their entire reflex apparatus emancipate more or less widely from the rest of the animal to become independent"; such reflex systems come to be defined by the author as reflex republics (*Reflexrepubliken*) (von Uexküll 1905: 69).

In the first edition of *Umwelt und Innenwelt der Tiere* this idea is taken up again and synthesized in the following manner: "When a dog runs, the animal moves its legs – when a sea urchin moves, the legs move the animal"; but how can it be that a system composed of autonomous organs, or even "single autonomous muscular fascicles" (von Uexküll 1909: 118), could act in a functionally unitary way? Uexküll's response is that in radially symmetric animals the overall coherence

[8]This formula, which is so pregnant in its conciseness, is taken up again by Uexküll in later works. He does so anytime it is necessary to underline the difference between the organisation of inferior and superior animals. See for example *A Foray into the Worlds of Animals and Humans*: "Of all the various things located in its surroundings, its environment only ever admits the same perceptive mark through which the paramecium, when stimulated, is caused to flee. The same perceptive mark, hindrance, always brings forth the same movement of flight" (von Uexküll 2010: 73).

of movement is ensured by the building-plan. If, however, we keep in mind that, for Uexküll, the building-plan has the status of a subjective theoretical construct, then this affirmation implies a recourse to the mysterious teleological *Naturfaktor* that lies behind the building-plan itself. And thus, as Uexküll himself admits, empirical investigation comes to a halt.

In front of this impasse, and consistent with Uexküll's new "environmental" interests, in the first edition of *Umwelt und Innenwelt der Tiere* the aspect of the biology of the sea urchin that is most clearly shown is the particular organization of its environment and its inner world – an organization that marks the passage to a higher level in comparison with unicellular organisms. If these unicellular organisms are limited to reacting to simple stimuli, the sea urchin instead seems to perceive the presence of relevant objects (prey, enemies etc.) through *stimulus combinations*:

> The objects we notice in the sea urchin's environment have no other way to affect it as individual, autonomous entities other than by producing a combination of stimuli which are specific to each of them. In other words: a sea urchin has no way to gain knowledge of the objects in its environment if it is not able to turn into muscle excitation the characteristic combinations of stimuli coming from each type of objects. Besides, the muscular excitation triggered by the combinations of stimuli must be able to exert different influences on the sea urchin; only so we can be faced with effective action of the object on the animal. Otherwise it would be a matter of non-unified stimuli, and the animals' environments would still have qualities, but not objects (von Uexküll 1909: 117).

The higher complexity of the sea urchin's environment, which Uexküll describes using a clearly Kantian terminology, is thus due to a (yet rudimentary) capacity to synthesize objects starting from the stimuli coming from sensibility. Such synthesis occurs only if the stimuli from which the combination is formed are presented in a certain chronological succession; the *Gestalt* that they form, in other words, is also diachronic. For example, the sea urchin's defense reaction towards the starfish is triggered by the appearance first of a chemical stimulation caused by the mucus present in the foot of the starfish, then by the mechanical stimulation due to contact with its enemy (von Uexküll 1909: 114).

The adequate reaction to the object thus results from the unification of two stimuli in a precise schema, which corresponds to the whole situation that the human observer calls "encounter with the starfish". Such correspondence, as Uexküll often emphasizes, occurs at the behavioural level, not in the conscious representation of the object. It is not based on the reproduction of the object itself by the sea urchin's nervous system but rather on a much more elementary process, that of the reception of a stable constellation of stimuli. In other words, for Uexküll it is fundamental to specify that at this level we cannot yet speak of a true *synthesis* of stimuli:

> [The starfish] is broken down by the [sea urchin's] receptors into its physical and chemical properties. No synthesis takes place in the nervous system. Only the coordination between the different muscles and glands [. . .] leads to the synthesis of a unitary action. [. . .] Unity finds itself only in the building-plan of the animal as a whole (von Uexküll 1909: 76–77).

The next step in the articulation of the environment of animals comes with the capacity to react to the *form* of the object, a capacity that "takes us to the threshold of the higher animal kingdom" (von Uexküll 1909: 167). Among invertebrates – or

rather in the subkingdom of animals that the first edition of *Umwelt und Innenwelt der Tiere* analyses – such a capacity can be found, for example, in earthworms (*Lumbricus terrestris*). When an earthworm needs to drag large leaves underground it is able to grasp them by their tip, and so the leaves roll up and can enter its burrow without difficulty. It should be noted that the earthworm's behavioral act of grasping the leaf by the tip is not preceded by any imitative learning or by trial and error learning, but only by the action of running its head along the sides of the leaf, without grasping it. To rule out that this feat could be explained on the basis of an eventual diversity in chemical stimuli coming from the stem or the tip of the leaf, Uexküll reports Elise Hanel's experiments.[9] In these experiments, the earthworm is presented with papers in the shape of an isosceles triangle (with a narrow base and very long sides); despite of the chemical homogeneity of the material, also in this case the earthworm shows it is able to grasp the paper by the tip.

From the point of view of environmental theory, the behavior of the earthworm faces the researcher with the problem of explaining the capacity to comprehend shapes without the sense of sight, which is completely absent in annelids and many other lower animals. Always following Hanel's analyses, Uexküll subdivides the behavioral sequence of the earthworm into a series of simple acts and hypothesizes that the animal, while it is running the anterior part of its body along the sides of the triangle, is able to distinguish the different times of its own movement according to where it finds itself: in correspondence with the base (short) or the sides (long) of the triangle. The sequence of proprioceptive stimuli that triggers the behavior to grasp the leaf with its mouth is therefore following: a short movement + angle + long movement + angle. Other sequences do not provoke any reaction whatsoever. In the "inner world" of the earthworm – or rather on the level of qualitative differentiation of environmental stimuli – this motor sequence can be described by the following: light intensity muscular stimulus + tactile stimulus + elevated intensity muscular stimulus + tactile stimulus.

Thus, according to Uexküll the shape is understood through a combination of proprioceptive stimuli; in the case above, at least four separate nerve centers must be present in the central nervous system of the earthworm. Each of these nerve centers is appointed the reception of one single stimulus. Uexküll holds that only in this way "external spatial relationships can be reflected by internal spatial relationships" (von Uexküll 1909: 165). This does not mean, however, that the earthworm "pictures" or mentally represents that shape, rather it is worked out in a series of stimuli that – in themselves – do not have any relationship of resemblance to the external object. What is established is a relationship of *non-mimetic formal correspondence* among the centers which are activated by the stimuli and the exterior shape of the object. So despite having a denotative function towards external events, stimuli and flows of excitation that pass through the nervous system remain neutral from an informative

[9] Elise Hanel was a German zoologist active in the early twentieth century. She studied the behavior of the earthworm in relation to Darwin's work. She also studied the reproductive process of the freshwater polyp.

point of view. On this point – which we will take up again and explore in-depth in the following paragraph – the following quote from the first edition of *Umwelt und Innenwelt der Tiere* is very clear:

> The coming and going of excitations is the only objective process that we can use to reconstruct the inner world of animals. Unlike the surroundings' multicolored variety, the quality of the inner world does not change. That is why dynamic excitations can be considered as a sign that something is happening outside, even if they do not resemble at all to the events taking place in the surroundings (von Uexküll 1909: 59).

Uexküll would return to the issue of the perception of shapes by the earthworm some years later, in *A Foray into the Worlds of Animals and Humans*. On the basis of new experiments, Uexküll explains the earthworm's behavior with the sole perception of taste: "As soon as one end [of a small stick] had been dusted with powder from the tip section of a dried cherry leaf and the other with powder from the stem section, the earthworms could distinguish the two ends of the sticks just as they were able to distinguish the tip and the stem of the leaf itself" (von Uexküll 2010: 82). In *A Foray into the Worlds of Animals and Humans*, in other words, the earthworm's behavior towards leaves is still "according to their shapes", but its real elaboration is due to perceptive marks that fall into the category of taste or olfaction.

In *A Foray into the Worlds of Animals and Humans* the animal environment in which "shape is a perceptive mark" (von Uexküll 2010: 84) is that of bees, or rather of an organism endowed with sight. Drawing from research from Karl von Frisch,[10] Uexküll observes that within the visual environment of bees the fundamental distinction is between open shapes (such as a star or a cross) and closed forms (such as a circle or a square). The biological function of such a distinction is evident: the model of the open shape is applicable to flowers that have blossomed, and that of the closed shape to buds (of no interest to bees). In the terminology used in *A Foray into the Worlds of Animals and Humans*, open and closed shapes are two *schemata*, or rather (Kantianly) two innate shapes of the experience that the bee has at its disposal and which activate in correspondence with adequate situations or perceptive images (*Merkbilder*). "It suffices to assume that the perception cells [. . .] are arranged in two groups, the ones according to the schema "open", the others according to the pattern "closed". Further distinctions are not present. If these schemata are transposed outward" – Uexküll continues – "they are filled up, in the case of bees, with colors and odors" (von Uexküll 2010: 84). Therefore, the level of existence of these schemata is first and foremost mental-cognitive; only later – after their transposition outward and their "finding" within the environment – can one speak of their perceptive existence.

The transposition into the Umwelt of perceptive schemata linked to shape constitutes a fundamental passage in the establishment of complex environments.

[10]Karl Ritter von Frisch (1886–1982). Austrian ethologist who in 1973 received the Nobel prize for medicine with Konrad Lorenz and Nikolaus Tinbergen. The passage cited by Uexküll comes from the 1927 work *The Dancing Bees* (von Frisch 1954); the quote from Frisch testifies to the attention that Uexküll paid to nascent ethology.

Shape, understood as a new way of interpreting stimuli, does not limit itself to just being alongside environment traits that are already present (odors and colors) but combines with them in a productive manner; the shape "receives" and organizes the other perceptive marks, establishing a relationship that goes far beyond mere association. As we shall see in Chap. 6, in *A Foray into the Worlds of Animals and Humans* the transposition into the environment of formal schemata will be the necessary precondition for the establishment of an environmental trait that is indispensable for higher animals and for man: the perception of the *function* of objects.

4.2 The *Gegenwelt*

In the first edition of *Umwelt und Innenwelt der Tiere* the analysis of the inner world, in particular of the modalities of reaction to shape, allows Uexküll to shed light on two important principles of organization of the environment. The first relates to the formal correspondence between the objects of external reality (the "surroundings" [*Umgebung*], as Uexküll often writes) and the constellation formed by the centers of the nervous system. The second is that of the non-mimetic nature of the relationship between the external reality and the inner world: neither the stimulus considered itself nor the configuration of the active nerve centers have any resemblance to the external elements that make up their base – put another way, the stimuli do not convey any informative content about the surroundings.

These two principles come together in one of the most relevant arguments in the first edition of *Umwelt und Innenwelt der Tiere,* which is that within the central nervous system of higher animals a counter-world (*Gegenwelt*) is established in which all relevant characteristics of the external world are rendered. The formation of the *Gegenwelt* presupposes that the sense organs of higher animals and their capacity to elaborate stimuli are much more developed than those of lower animals. A large part of vital functions in lower animals – despite their complexity in terms of motor execution – are due to reflexes triggered by isolated stimuli or by simple combinations of stimuli. For Uexküll the construction of an inner world which is articulated and linked to the exterior world by relations of mirroring – he never uses the term of representation, which he considers too close to the discipline of psychology – occurs due to the availability of complex neural networks which allow for a high degree of diversification in stimulating pathways.

Before we tackle this point, however, it is necessary to take an in-depth look at a central point. If stimuli do not convey any informative content and they clearly are not "transparent" towards the surroundings, what does Uexküll mean when he states that the counter-world is established through mirroring? The answer brings us closer to one of the most fascinating aspects of the Uexküllian idea of the environment, which is to say that between the subject (human or animal) and the external reality there is a semiotic relationship, of *interpretation* or even *translation*, whose result is the constitution of the species-specific environment itself. This relationship –

which would be explicitly thematized in one of Uexküll's last writings, *A Theory of Meaning*, and which would earn him the attention of modern semiotics – was already underlined in the first edition of *Umwelt und Innenwelt der Tiere*:

> As we know, all the receptor organs have the same task: to turn into excitation stimuli from the external world. In other words, in the nervous system it is not the stimulus itself that sets forth, but, instead, there appears a completely different process, which has nothing to do with environmental events. This has to be read as a *sign* that a stimulus is present in the environment and that it has encountered a receptor. Nothing is said about the quality of the stimulus. Stimuli from the external world are globally translated as a nervous sign language [*in eine nervöse Zeichensprache*] (von Uexküll 1909: 192; the same concept is repeated on page 59 of the same text).

In other words, Uexküll believes not only that nerve stimulations lack any specific content relative to the surroundings, but also that they are by origin qualitatively homogenous, or rather indistinguishable in tactile, optical, olfactory etc. stimulations. The differentiation among different "sensory categories", which man and (very probably) higher animals experience as primary, is due to the mediation of two factors. The first is the introduction of obstructive thresholds on the level of receptors, which allows for the selection of only those environmental stimuli that exceed a minimum level of intensity; this strategy differentiates stimuli on the basis of quantitative criteria, which however – in the establishment of the *Gegenwelt* – counts *tout court* as criteria for typological identification. The second factor, which is much more relevant, lies in the fact that the waves of excitation coming from different receptors run through different pathways in the central nervous system. Just as in the first, the second distinctive factor does not jeopardize the intrinsic homogeneity of the "quanta of excitation" that come from the receptors.

Uexküll states that the modality of differentiation on the basis of threshold values is prevalent in lower animals, while in higher animals the second modality predominates: their nervous system "possesses a large number of centripetal pathways and is therefore capable of distinguishing among types of stimuli, even on the basis of very subtle distinctive features" – where "to differentiate" means to transform the intrinsic homogeneity of external stimuli in the relative difference of the quanta of excitation by means of the passage through different pathways of the nervous system. Moreover, in superior animals the quanta of excitation coming from different receptors do not converge in the nerve system in a generic way but instead flow out into "isolated networks"; each of these networks act as specific points of collection for a determinate "combinations of excitation" (von Uexküll 1909: 193), which, over time, restores to the subject the combination of exterior stimuli (deprived of any distinctive characteristics by that point).

In the first edition of *Umwelt und Innenwelt der Tiere*, this completely inner process of collection and organization of stimuli is of the utmost importance. In fact, it not only makes possible the great sensorial richness of the environments of higher animals, but it also brings about the synthesis of more stimuli in *unitary objects*: "The combinations of stimuli could be concisely called objects, as a result of which the nervous system of an animal that reacts differently to different combinations of stimuli could be considered apt to recognize objects" (von Uexküll 1909: 192).

The presence of stimuli combinations, despite being a necessary condition, is not sufficient to completely explain the formation of objects in superior environments. For this to be, Uexküll states, it is necessary that the animal's nervous system come to "mirror" the spatial extension of the object, which is lost in the reduction of the object to a sequence of stimuli. As we have seen in the case of the earthworm, according to Uexküll this mirroring requires the concrete reproduction of the arrangement of the "sources" of the stimuli within the central nervous system:

> The spatial organization of the stimuli is lost if it is not placed in an analogous spatial organization of the neural pathways. We understand here the importance, for the organizing plan of the central nervous system, of the fact that different types of stimuli are not given by different types of excitation within nerve fibers themselves, but by the use of different nerve fibers. The types of excitation could not be organized in space consistently with the objects' shape, whereas this is possible for nerve fibers (von Uexküll 1909: 194).

Later in Uexküll's dissertation he mentions that the correspondence between the elements of the external world and the networks of the nerve and cerebral centers – starting from this level of complexity, the brain matters more than the central nervous system in terms of its specific functionalities – should not necessarily be thought of as a strict isomorphism:

> It does not matter how we wish to consider the organization of nerve fibers, i.e. if a circular or triangular organization of the nerve fibers can fit a circle in the environment, or vice versa. What counts is that the differentiation of the spatial configuration of objects in the central nervous system and in the brain requires a stable distribution of the neural pathways (von Uexküll 1909: 194).

This observation, which Uexküll does not develop further, could indicate that the brain of higher organisms is capable of utilizing with great flexibility not only the quanta of excitation (which are "interpreted" on the basis of the pathways they run in the central nervous system), but also the entirety of the nervous system pathways run by a group of stimuli. The "reading" and the use as much of singular quanta of excitation as of the spatial ordering of active fibers, in other words, would constitute processes that are not merely associative but rather already symbolic: quanta of excitation and configurations of nerve fibers "would stand for" external entities with which they would have no relation of similarity. The brain of superior animals, Uexküll continues, "not only does it know the environment through a language of signs, but it reflects a piece of reality in the spatial connections that take place between its parts" (von Uexküll 1909: 194). The path traced by a stimulation through different cerebral junctions constitutes a *Gestalt* which the subject *treats as a semiotic nexus*, interpreting it and translating it into a lived environment – whose congruence with the external world, however, can never be verified.

Beyond the notion of signs, a recurring metaphor of the mirror runs throughout the determination of the concept of counter-world. In the first edition of *Umwelt und Innenwelt der Tiere* the *Gegenwelt* is even defined as "mirrored world (*Spiegelwelt*)" (von Uexküll 1909: 195), while in an article from the same period, *Die neuen Ziele der Biologie* [*The New Objectives of Biology*] (von Uexküll 1910c; edition used in von Uexküll 1913: 35–53) the central nervous system is defined as a "mirror of nerves" (*Nervenspiegel*) (von Uexküll 1913: 49). Uexküll himself, however, urges

prudence in using the idea of mirroring: in the case of the counter-world we are not in fact dealing with an exact reproduction of the external world but rather with a formal, non-isomorphic correspondence, which – as is made clear from the quoted passages – comes close to a relationship of denotation among heterogeneous elements (a triangular "nerve schema" can stand for a circular shape in the external world).

Despite these limits, the idea of mirroring helps Uexküll to maintain that there is a close relationship between animal and environment: "The environment, as reflected in the animal's counter-world, is always part of the animal itself" (von Uexküll 1909: 196). It is no coincidence that the increasing complexity of organisms corresponds to a higher complexity and precision of their counter-world; in superior species the presence of new organs – for example binocular vision or the semicircular canals of the ear – correlates with the progressive increase in environmental characteristics. However, this correlation never calls into question the basic assumption that the mirroring of the external world within the internal world is neither a direct representation nor a mimetic reproduction, but rather an active subjective production. This also holds true for those aspects of experience that we all tend to spontaneously attribute to the world, and not to the activity of the subject, such as color, odor and the space-time organization of objects:

> Just as lower animals choose the most appropriate chemical and physical stimuli, higher animals put to use their highly developed visual system to find appropriate shapes, colors and motions, the ones that can act as linking point with their reflexes and on which they depend exclusively, sailing carefree and safe in the incommensurable exterior world. The environmental stimuli establish at the same time a solid dividing wall, which surrounds the animal like the walls of a house it built itself, and keeps away the whole world and its extraneousness (von Uexküll 1909: 212).

Here we begin to glimpse an inherent problem in the premises of the Uexküllian environmental conception. If the external world is the object of a problematic, non-mimetic mirroring on the part of the subject, or even a co-product of the subject made by an interpretive and "translating" work carried out on nerve stimulations, then the external reality in itself, the non-interpreted and non-translated surroundings, will always remain unknown. Uexküll's problem here comes from his adherence to transcendental Kantian philosophy, in which this problem is present as the noumenon problem or of the thing in itself; and, just as in the case of Kantism, the inaccessibility of the external world would be one of the main objects of criticism of readers of Uexküll. As we shall see, the most direct criticisms of the ideas of Uexküll on the inaccessibility of the external world come from Lorenz, who would see a form of environmental solipsism which not only leaves the presence of adaptive relations between the external environment and the cognitive categories of the subject unexplained, but obligates the researcher to postulate the existence of sovra-empirical forces which can bear a harmonizing function between the organism and the external reality (see *below*, 217).

The concept of the counter-world begins to see a progressive decline in importance from the second edition of *Umwelt und Innenwelt der Tiere*, until it completely disappears in *Theoretische Biologie* and *A Foray into the Worlds of Animals and Humans*. The hypothesis that the inner world of animals is established starting

from schemata which are understood in a physical sense, or rather from networks of nerve fibers delegated to reproducing – through a problematic "non-mimetic resemblance"– the shapes and qualities of the exterior world turns out to be difficult to maintain and, more importantly, difficult to study in-depth with empirical analysis. This does not mean, however, that the problem which this has created would disappear. In later works all knowledge structures (the schemata, space, time) will no longer be understood in a physical sense but rather in a transcendental sense (or, to use more current terminology, cognitive), but the Uexküllian stance regarding the relation between the subject and the external world will not change: the species-specific environment shall remain the product of the application of those structures to stimuli-signs of unknown origin.

4.3 The Reperceived Environment as a Species-Specific Transcendental Construction

The presentation of the beginnings of the environment concept in the second phase of Uexküll's production cannot be complete without discussion of one of the themes that most fascinated him: the lack of coincidence between the environmental components of which the animal is aware and the components that enter into its sphere of action – that is, the separation (which can be partial or total depending on the species) between the felt (or reperceived) environment and the "environment for the behavior" (Merleau-Ponty 2003: 167).[11] The first clear formulation of this problem (which was present in the background of previous works) is in the cited article *Die Umwelt*, which we shall analyze now in greater detail.

> As far as lower animals are concerned, the sense organs' and the effector organs' environments are clearly separate. The more we climb the sequence of animal forms, the bigger the sense organs' environment, overlapping that of the effector organs. In lower animals, the shape and texture of objects reflect themselves precisely upon the tools [i.e. on the organisms' specialized limbs], and only meet the sense organs through vague olfactory and tactile stimuli. On the contrary, in higher animals, the relationship between sense organs and objects is much closer, whereas the limbs become less and less specific, to finally become, like a human hand, organs suited to any object of a certain size. What happens is that the environment of us humans is exclusively the environment of our sense organs, where our effector organs also exist as objects of the environment (von Uexküll 1910a: 641).[12]

[11] As it is pertinent we shall take an expression used by Merleau-Ponty, who in his presentation on Uexküll's contributions to contemporary natural philosophy distinguishes between environment "for the behavior of an animal" and environment "for its consciousness" (Merleau-Ponty 2003: 166); Merleau-Ponty demonstrates how for Uexküll the species-specific environment was the integration of these two elements, and how also in the first type of environment the characteristic of *meaningfulness* is phenomenologically present.

[12] The reference to the hand of man puts Uexküll in a long line of thought that – from Aristotle to Gehlen – sees manuality as one of the characteristic traits of the human being.

This phenomenon which Uexküll underlines is a sort of inverse proportionality between the specialization of effector organs and sense organs. Consider an organ such as the stinger of a mosquito; when faced with the perfect specialization of its structure, which imposes a sort of obligatory path to the nutritive behavior of the insect, the amount of re-perceived environment that allows for its use can be very limited – for example restricting its detection to a determinate threshold of corporeal heat. Uexküll notes that the wider and more differentiated the field of perception gets the more plastic and variable the possible behavior becomes and thus the effector organs, too, must be more versatile. What is important is to avoid projecting onto lower animals the breadth of perception and object stability natural to the world of man; only in this way can one at least intuit the peculiar organization of the animal Umwelt, in which not everything that is needed for action is present in consciousness.

Faced with this task Uexküll dedicates a number of pages in *Die Umwelt* to specify the way in which the human observer can access the field of perception of lower animals. From a methodological point of view, it is possible to follow a different path than the one taken in the first edition of *Umwelt und Innenwelt der Tiere*; here one attempted to delineate the differences among environments beginning with the simplest of species and then progressively dealing with the more complex, but the opposite can also be done. The organization of species-specific environments can thus be investigated, so to speak, through subtraction, or rather starting from the world of man and eliminating the objects and object properties from it that are irrelevant for animals:

> In the small book *Umwelt und Innenwelt der Tiere* I attempted to outline the relationships between animal and environment for certain biological species, starting from the simplest animals (with the simplest environments) and pointing out how body differentiation of animals goes hand in hand with a richer and more varied environment. However, it is just as legitimate to start from man, decompose its organism piece by piece, and observe which alterations on the environment [this process] would necessarily bring about (von Uexküll 1910a: 641).

It is clear that, in its concrete realization, what Uexküll defines as "decomposition of the organism" turns out to be a decomposition of the environment-animal system.

As far as man is concerned, this theoretical operation allows us to examine an element which Uexküll had not yet approached but which would take on significant importance in his later work: that of human language. Starting from the world of man and proceeding by subtraction does not in fact mean starting from the objective sphere of external reality in order to arrive at animal environments understood as its subjective modifications; the world of man, too, is a product of the sensory and cognitive apparatus of a subject, but of a subject that has a symbolic instrument in its language capable of enlarging its experience enormously, to the point in which it includes even the environments of other species. To deconstruct the human environment in order to deduce the environments of lower animals is a procedure that cannot help but take into consideration the "relationship of language with the environment" (von Uexküll 1910a: 641), that is the linguistic structuring of the

human environment. This structuring must first be understood and then abandoned in order not to make the error of projecting it onto the environments of non-linguistic species.

In terms of comprehending the cognitive acquisitions allowed for by language, Uexküll – with explicit reference to Karl Camillo Schneider[13] (von Uexküll 1910a: 642) – points out how the human capacity to give names to objects brings with it two cognitive acquisitions of extreme importance, which immediately express themselves in superior environment features. On one hand, language gives us the opportunity to emphasize the different *function* that the object has in specific environmental situations, while on the other, it gives us the possibility of "fixing" the existence of the object, of giving it a duration which is independent from its permanence in the sensory field. "Speech" – Uexküll writes – "makes us independent from the casual presence of objects"; thanks to this, objects "are not merely temporary appearances, but have a future and a past" (von Uexküll 1910a: 642).

The two cognitive acquisitions that man owes to language are closely connected to one another: independence from the momentary perception of linguistically stabilized objects is a necessary condition of their carrying-on of different functions and qualities. "Things" thus become centers of identity capable of cognitively supporting the change of states and qualities, a process which can be attested to by the momentary perception of stimuli. Moreover, the possibility of their mental recall through name allows man to arrange and organize among the functions and properties of various objects with a quickness and flexibility unavailable to other animals, for whom the elaboration (creative as well) of environmental data is anchored to the physical presence of the objects. And the possibility to establish relations among objects even *in absentia* is a fundamental requirement for the technical productivity of man.

In *Die Umwelt* Uexküll does not go so far as to make a detailed analysis of the consequences of language on the cognitive organization (and thus on the environment) of man, and the issue of language is not developed further. Once light has been briefly shed upon the fundamental features of objects in the human environment – persistence, the independence from immediate perception, the multiplicity of functions and qualities – Uexküll moves on to analyzing the implications of the *absence* of this type of objects in the animal environment, and primarily the lack of regular causal links:

> If we found ourselves in a world where all the objects were just temporary appearances [*Augenblickerscheinungen*], we would not be able to pass judgment or draw conclusions, because causality, which acts only in time, would be absent. Hitting us from all fronts, sensorial impressions (from the weakest to the strongest) would maintain our precarious

[13]Karl Camillo Schneider (1867–1943). Austrian zoologist, worked in the zoological stations of Naples and Rovinj. Professor of zoology at the University of Vienna from 1905 to 1932, where he initially dedicated himself to histological and anatomical research, then later to animal psychology, anthropology and parapsychology.

> balance, out of which we would be pulled only by the appearance of an object belonging to our food or to our enemy spheres, which would make us act. This is how we should picture the environment even of higher animals (von Uexküll 1910a: 643).[14]

The subjective environmental experience of superior animals includes two classes of phenomena: on one side, sensory impressions without biological interest (a sort of iridescent background which is neutral in value), on the other, objects endowed with a single function whose duration coincides with the effective presence of the object in the animal's field of perception.

The next passages in the deconstruction of the human environment – and therefore in the comprehension of the most elementary of the environment-organism systems – are the loss of spatial arrangement of experiences, the loss of shape and the decomposition of the objects into their properties. The loss of spatial configuration, which concerns the environments of invertebrates, depends on the fact that they do not possess the organ assigned to orientation (semicircular canals). According to Uexküll, such an organ, which in mammals is located in the ear, is accountable for the creation of a system of coordinates centred on the subject; in other words, it is the anatomical-physiological presupposition for the insertion of the subject and the objects in the same space. In its absence the only possible form of relationship between the organism and the objects is the mere impact of the stimulus on the receptor, a sort of collision that does not imply the placement of the source of the stimuli in a precise point of external space (and probably not even a definite perception of the spatial extension of the organism itself).[15]

Even though it is implicit in the loss of spatial arrangement, the second feature of the simplification of the human environment into inferior animals – the loss of shape – deserves for Uexküll a separate treatment. It is, in fact, the "loss of our objects' most important quality", the quality which confers unity to an object and characterises it as such. To fully understand the implications of this, we must remember that Uexküll interprets the phenomenon of the perception of shape by a human subject in explicitly Kantian terms:

> According to Kant's theory, we dominate the variety of the shape of the objects that surround us thanks to memory, which retains the characteristic shape of objects in the form of simple monograms or schemata. These schemata can be sketched out roughly or very specialized, depending on whether our interest towards the objects is limited or more significant. [. . .] Kant's theory can be applied to the brain, assuming that its [nerve] centers are organized in the form of monograms and schemata (von Uexküll 1910a: 644; see also Kant 1999: 274).

As clearly shown in the quote above, in the reading that Uexküll makes of the Kantian theory of transcendental schematism the ontological status of schemata – which are truly responsible for the grasping of shape in superior animals – is no

[14] In Chap. 7 we shall see the reception of this feature of this Uexküllian concept on the part of authors such as Cassirer and Langer (*cf. below*, 188–197).

[15] On the concept of impact in mechanical theories of environment and behavior and its Cartesian origin see G. Canguilhem 2008: 186.

longer *operational* but rather *material*: if in Kant these are transcendental functions of the conscience, in Uexküll they become networks of physically existing nerve centers.

This must then be put in relation with the Uexküllian concept of the counter-world which we have previously analyzed: in animals the coherency between the inner world and the environment is based upon formal correspondences which are not representative or mimetic but rather comprise an interpretative moment: the *reading* of the schema, the grasping of "for what" something stands for. The Uexküllian use of the Kantian notion of schema is a confirmation that, for Uexküll, there is a semiotic-denotative relation between the environment and the organism, which occurs even in the absence of language.

Incidentally, this also raises the question of the philosophical correctness of the way in which Uexküll uses this Kantian notion: in the quote cited above, he considers the terms *monogram* and *schema* as equivalents, neglecting the fact that the former is a mark which stands for something else, while the latter (at least in the original Kantian notion) is the condition of possibility of the phenomenal presenting of a given experience; a monogram, in other words, has a semiotic-denotative function that transcendental structures understood from a Kantian perspective cannot have. In the Uexküllian concept of schema, rather, denotative function and transcendental function come to coincide.

Returning to the "scale of environments" described in *Die Umwelt*, Uexküll states that on the level of inferior animals the schemata available diminish in number and become ever more generic. This also brings about the reduction in the number of objects that the animal is capable of perceiving. In environmental experiences lacking the perception of shape, for example, receptors are used to grasp – a "grasping" which is also always a "producing" – other characteristics of the environment, such as the presence of light, color, and movement. And it is evident that an animal deprived of formal schemata will grasp non-formal characteristics (such as color) without simultaneously attributing them to objects; those characteristics will be perceived as isolated stimuli, but still perfectly capable of triggering a complete behavioral reaction.

Citing the research of Rádl,[16] Uexküll shows how the environment of many invertebrates nothing but "a system of dark or illuminated patches" (von Uexküll 1910a: 645), where the exact contours of the single patch play no role (in these cases, Uexküll says, the required perceptive precision is ensured by the senses which, like touch and smell, also function independently from the unification of stimuli in object links). In regard to these environmental experiences, Uexküll affirms:

[16]Emanuel Rádl (1873–1942). Czechoslovakian biologist and philosopher, he was interested in the central nervous system and the phenomenon of animal phototropism; his interests in theoretical biology and the philosophy of nature focused on Goehte, Leibniz and Stahl. In the 1910s he obtained a certain notoriety thanks to his publication *Geschichte der biologischen Theorien seit dem Ende der siebzehnten Jahrhunderts* (Rádl 1905–1909). After World War I he became a university professor and his interests shifted towards political philosophy, specifically the relationship between religion and politics.

> We are faced with the phenomenon, very typical in lower animals, of the *dissolution of the objects in their properties*. For a crab, a chunk of fish, which for us is a unitary object possessing a certain shape, color, smell, texture and taste, splits into two parts: into a visible object, which is separately perceived only through movement, and an invisible one, which gathers the remaining qualities that play a role in the feeding behavior (von Uexküll 1910a: 645).

The second part of the object in included in the environment for behavior, or operative environment, but not in the felt perceptive environment.

This process which Uexküll defines as "dissolution of the objects" can be pushed a step further, to the point of the establishment of very poor perceptive environments, made up only of elementary stimuli that trigger largely automatic reactions. In these cases, to speak of "objects" is legitimate only if we remember that it is the human observer who occupies the animal environments of shapes and contours; it would be better to avoid such a term, which brings with it the danger of anthropomorphizing the experience of the animal subject. In Uexküll's opinion, one can obtain a greater deal of precision either by speaking of "smells and impacts", always from a subjective point of view but scientifically acceptable nonetheless, or by translating these terms into objective ones of "chemical and mechanical stimuli" (von Uexküll 1910a: 645). Once we have overcome the tendency to make stimuli perceived by the animal subject correspond to as many objects, both of the paths are correct. In terms of the proper approach, Uexküll writes in the conclusion of his article that he prefers to avoid the reduction of animal perception to chemical-physical factors and thus holds to the peculiar perspective of the transcendental subject – of a transcendental subject, however, which gives life to an environmental experience which is qualitatively different from that of human beings.

The distinction between environment for consciousness and environment for behavior is present in all of the cases that we have taken into consideration; what varies is the proportion that exists between the felt part and the only "acted" part of the environment. Thanks to language, in man the sector of the environment that is accessible to consciousness extends widely and is highly articulated; in animals, and specifically for invertebrates and unicellular organisms, the part which is accessible to consciousness is always lesser, and blind behavior becomes prevalent. In these last cases, it is not consciousness which guides and unifies animal action but rather directly the building plan of the organism, particularly the nerve structure of its "inner world": "The environment of every animal can be divided into two worlds, a world of action and a perceived world, which become a unified whole in the animal's inner world" (von Uexküll 1921: 218).

To conclude this initial presentation of the Uexküllian concept of Umwelt we have shown that, since the publication of the first edition of *Umwelt und Innenwelt der Tiere*, Uexküll was fully aware of its importance as well as of the potential for misunderstanding which came with it. In the article entitled *Die Merkwelten der Tiere* [*The Perceptive Worlds of Animals*] (von Uexküll 1912: 349–355; edition used in von Uexküll 1913: 67–76), Uexküll states:

> For this world [*Welt*], which is the product of the organism, I tried to coin the term "environment" [*Umwelt*]. The word took root quickly – not so much the concept. Today

> the term "environment" is used to indicate the objective surroundings [*Umgebung*] of a living being, in the same sense as the previously used term "milieu". However, this way it misses its genuine meaning (von Uexküll 1913: 71–72).

Once again mentioning the erroneous interpretation of the term Umwelt which he introduced, Uexküll continues:

> In today's debates, the first thing that comes to mind is the operative world when we use the term environment [Umwelt] as a synonym of the animal's physical context [milieu], thus tacitly admitting that the objects which make up the specific operative world (for example the leaves eaten by a caterpillar or the water where a fish swims) definitely influence its sense organs. But here is the crucial mistake. Drafting the list of single objects in the operative world [...] becomes utterly secondary [...]. The discovery of the perceptive world of single species, on the other hand, is a fundamentally new and complex task, which can only be undertaken experimentally (von Uexküll 1913: 71–72).

Uexküll's fear of the possible misunderstanding of his theory turned out to be both well-founded and excessive. Excessive because the term Umwelt – and its equivalents in other languages (environment, *environnement*, *ambiente*) – have effectively been confirmed on an international scale, and because its semantic sphere is wider than the mere reference to the physical context of organisms; the environment is ever more and more understood as a network of dynamic connections, which include the conferring of meaning and interpretative biosemiotic activities. But, as we shall see in the conclusion of this work, Uexküll's fears turn out also to be well-founded because two fundamental (even if problematic) features of his concept of environment have gone missing: the rootedness in Kantian philosophy and the concept of fixity and immutability of the species-specific environment.

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Chapter 5
The Structure of the Umwelt

Abstract Basing on the second edition of *Umwelt und Innenwelt der Tiere* and on *Theoretical Biology*, the chapter proposes a more in-depth analysis of the Uexküllian Umwelt. Starting from the notion of functional circle, i.e. from the interplay of operative and perceptive organs in each animal species, the chapter focuses on the role played in the constitution of the Umwelt by different kinds of signs (effect signs, moment signs, directional signs, etcetera). According to Uexküll, both perception and action are ultimately based on internally generated signs, that are then outward transposed (*hinausverlegt*) and thus produce the species-specific Umwelt – a conception that can be defined as *transcendental biosemiotics*.

Keywords Functional circle (*Funktioskreis*) • Effect organs • Perception organs • Signs • Outward transposition (*Hinausverlegung*) • Uexküll's theory of action

5.1 The Functional Circle

The third phase in which we have subdivided the production of Uexküll, from 1918 to 1944, includes works which are heterogeneous both in terms of the subjects dealt with and with their level of inquiry. We find a significant number of works that are fundamental from a scientific point of view, such as the second edition of *Umwelt und Innenwelt der Tiere* and *Theoretische Biologie*, as well as popular works like *A Foray into the Worlds of Animals and Humans*. In order to orient oneself in this vast production, it is opportune to start from an analysis of the second edition of *Umwelt und Innenwelt der Tiere*, which allows us to compare two versions of the same text and to identify which elements Uexküll believed out-of-date (and thus were left out of the second edition), which elements remain and, finally, what new concepts make their first appearance. The next step shall be the presentation of the contents of *Theoretische Biologie*, which, as we shall see, is entirely consistent with the modifications made in the second edition of *Umwelt und Innenwelt der Tiere*. The 10 years that passed from 1909 to 1921 (that is between the two versions of *Unwelt und Innenwelt der Tiere*) seem to be fundamental in the elaboration of the environment concept and for Uexküll's theoretical biology in general.

Let us first turn to the comparison of the two versions of the work. Already at first glance, one of the most relevant divergences is found in the disappearance of

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the chapter on "The reflex", which in the second edition is replaced by the chapter entitled "The functional circle" ["*Der Funktionskreis*"]. At the base of this change, we can identify two orders of factors that are closely linked to one another. This change is the key to understanding the development of the Uexküllian concept of environment.

First of all, scientific research in the first two decades of the twentieth century demonstrated how the model of reflex movement – ultimately reducible to the schema of stimulus/reaction – had severe limits, especially when one attempted to apply it to processes of elevated complexity or to articulated behavior. In terms of its explicatory value, such a schema had achieved great importance with Loeb and Pavlov, only to be criticized by scientists such as Jennings,[1] theorists like Merleau-Ponty, and *Gestalt* psychologists (cf. *above*, 60). Examining animal behavior in particular, many critics of the theoretical hegemony of reflex-based models agreed that an exterior stimulus could not be considered *tout court* as the cause of behavioral acts. Often intra-organic conditions, the autogenous rhythms of excitation, threshold values and other internal factors proved to be equally decisive in determining action (Merleau-Ponty 1967: 7–32).

Second of all, in the first edition of *Umwelt und Innenwelt der Tiere*, Uexküll had already got to spontaneously integrating the notion of stimulus with the notion of the species-specific environment. For him, a stimulus is part of an ordered whole, i.e. the environment, which first and foremost depends on the animal's receptor organs (and so from its overall building-plan, of which the organs are components). Already this is sufficient in order to remove a large part of the assumed originarity of stimulus: after being introduced into biology with the intention of retracing processes and actions to prior, accurately isolatable causes (thus banning any of their finalistic interpretations), with Uexküll the stimulus (and the reflex movement) loses its status as *causa prima* and comes to depend on the overall structure of the organism. This structure selects sensory influences moving from the particular needs of the species in question. And it is evident that in such a way the stimulus returns into an explicative context that is holistic if not directly teleological.

It is no coincidence that already in the first edition of *Umwelt und Innenwelt der Tiere* the "pure form" of the reflex arc (von Uexküll 1909: 61) lost importance in favor of behavioral modalities triggered by the recognition of stimulus combinations or even of object shapes and contours – a cognitive phenomenon that implies the presence, at least in higher animals, of *schemata* capable of ordering stimuli into constructions endowed with meaning. In the face of this role limitation that simple stimuli have, it is no surprise that in the second edition of *Umwelt und Innenwelt der Tiere* the chapter dedicated to the treatment of muscular reflex disappears entirely, substituted by a chapter on the functional circle – a much more dynamic and

[1] Herbert Spencer Jennings (1868–1947). American zoologist who studied at the University of Harvard and the University of Jena, then researched at the Zoological Station in Naples (first in 1897, then in 1903–1904). His field of activity concerns the physiology and behavior of protozoan; concentrating on the reactions of individual organisms to environmental stimuli, Jennings contested the legitimacy of the Loebian concept of tropism in the animal kingdom (starting with the simplest of organisms) (Jennings 1906).

articulate notion, as we shall soon see. Just as the reflex arc, in fact, the functional circle is a theoretical model aimed at connecting the inputs of the external world to the animal's behavior. If compared to the former, however, it has the advantage of explaining such interactions not only for single instants but also on the much broader temporal arc established by the life cycle of the animal – thus introducing into biology the idea that the cognitive relationships that the organism has with the environment also depend on the life phase that it is going through.

Before embarking on a more detailed explanation of the notion of the functional circle, it is necessary to shed light on a further theoretical limit of the concept of reflex arc. Such a limit – which becomes most evident when the concept in question is applied to higher animal behavior – consists in the fact that psychological and ethological theories centered on the concept of stimulus do not deal in an analytical way with the problem of the level of awareness of the stimulus itself. In most cases it is taken for granted that the stimulus that triggers a reaction is *felt by the organism* (understood as a perceptive center); this, however, is often not only indemonstrable but in many cases not even required in order to explain the reaction itself.

In other words, the psychology based on the concept of stimulus and often even later cognitivist psychology take for granted that animal behavior presupposes the same type of "directed" consciousness that is present in man. On the contrary, Uexküll is more careful to clearly distinguish the sphere in which the animal acts and the sphere in which the animal perceives in a conscious way (or, in other terms, feels or reperceives). As early as *Bausteine zu einer biologischen Weltanschauung*, Uexküll traced three distinct spheres from a conceptual perspective around the animal subject: the perceptive world (*Merkwelt*), the operative world (*Wirkungswelt*) and the environment (*Umwelt*) (von Uexküll 1913: 67–76).

The perceptive world for Uexküll is "a particular world composed with the features the animal itself perceives of the outside world"; it "depends entirely on the organization of the animal's sense organs and central nervous system", and thus also on the species-specific building-plan (von Uexküll 1913: 72). The perceptive world "is completed by the "operative world", which encompasses the objects that fit the animal's feeding and locomotion organs", but which are not necessarily felt by the subject on a cognitive level (or, in other words, do not enjoy any form of representation or awareness) (von Uexküll 1913: 72).[2] Among the clearest examples of objects that are present in the operative world but not in the perceptive one are the elements that allow for movement, such as air for birds or water for fish.[3] In the end, the environment can be considered the union of the perceptive world and the operative world.

[2]It is interesting to note in this central step how Uexküll defines the nutritive and motor organs with the term *Werkzeuge*, which means instrument or utensil, seemingly underlining that they do not directly call into effect the perceptive or representative faculties of the organism.

[3]The mention of water as an element of the operative world (and therefore not reperceived by the animal) is clarified in these terms: "The media [*Medien*] where the animals live, like air or water, are not perceived in any way, although the animals' locomotion organs are perfectly adapted to them" (von Uexküll 1913:73).

All three of the world-spheres – perceptive world, operative world and environment – are species-specific. Starting from this supposition, the experimental investigation into the operative world of animals must set two main objectives: first identify which characteristics of objects animals react to; second verify if (in order to trigger the action) said characteristics must be linked to one another by precise spatial or temporal relations (which would then lead to the hypothesis of the presence of cognitive schemata capable of "standing for" the relations which are present among the objects).

Appropriate investigation reveals that even the animal species that share the same operative world can have completely different perceptive worlds. The perception of the same object – what the human observer recognizes as such – can occur in the animal in a completely different way.

> The starfish, for example, displays the following chain of characteristics for the scallop (*pecten jacobaeus*): first visual awareness of movement, then a chemical stimulus, then a tactile one. In the sea urchin's perceptive world it is represented by another chain of characteristics, also arranged chronologically: first a weak chemical stimulus, then a stronger chemical stimulus, then a tactile one (von Uexküll 1913: 72).

This example demonstrates how other living beings are more relevant than inanimate objects in the perceptive world, particularly enemies, prey or sexual partners. This point has particular importance for our discourse; for Uexküll, primarily in higher animals and man, the perceptive world is the foundation of environmental experience and the departure point for behavior or action.

In the second edition of *Umwelt und Innenwelt der Tiere* the distinction between the perceptive world and the object sphere which, despite not being perceived, sustains the action of the organism (i.e. the operative world) is at the base of the concept of functional circle. This is particularly relevant if we recall that the notion of functional circle replaces the concept of reflex arc, carrying out the same function – connecting perception and action – but avoiding its theoretical limits. It is already evident at this level of analysis that one of the advantages of the functional circle concept is that it no longer demands every behavioral act be triggered by the noticing of a stimulus: in the very idea of the operative world there is the inherent possibility of a behavioral modality that is simultaneously "blind" from a representative point of view, but functional to the needs of the organism.

Let us move on to a more precise description of the functional circle as it is laid out in the second edition of *Umwelt und Innenwelt der Tiere*. The functional circle is preliminarily defined by Uexküll as "a general schema that underlies the relationship between any animal and the world" and the base of "the unity that every animal establishes with its world" (von Uexküll 1921: 45). After reaffirming that the environment is made up of different elements for every species – "The earthworm's world is made up only of earthworm things [*Regenwurmdinge*], in the dragonfly's world there are only dragonfly things [*Libellendinge*]" (von Uexküll 1921: 45) – Uexküll emphasises that

> The things present in the environment are characterized by the double relationship they have with the animal. On one hand, they send specific stimuli to the receptors (sense

> organs) of the animals, on the other hand they provide the effector organs (operative organs) with specific gripping surfaces. [This double relationship] makes it possible to divide the environment into two parts, i.e. in a *perceptive world* [*Merkwelt*], which comprises the stimuli of the things present in the environment, and in an *operative world* [*Wirkungswelt*] made of the grasping surfaces offered to the receptors. The stimuli sent out at the same time by an object present in an animal's environment become a *perceptive mark* [*Merkmal*]. So the aspects of the object responsible for sending out stimuli become *perceptive mark carriers* [*Merkmalträger*] for the animal, while the aspects of the object that serve as grasping surface become *operative carriers* [*Wirkungsträger*] (von Uexküll 1921: 45).[4]

Only to the human observer do perceptive marks and operative carriers appear unified in a single object; for animals these are *unified on a behavioral plane, but not on a representative or cognitive one*. The animal, in other words, is aware only of the perceptive marks. It does not reperceive in any way the object features which are for it operative carriers (for example, it does not feel the presence of water or air, even though they allow it to move).

On the object side, the perceptive signs and operative supports are connected to one another by a common substrate that Uexküll defines as *counter-structure* [*Gegengefüge*]; the counter-structure, in other words, is none other than the object as a *de facto* unit, but not as a unit experienced by the animal. The choice in terminology aims to prevent the animal from being attributed a full object understanding of the things present in the environment (which, according to Uexküll, is only possible for the human observer). As an example, in the nutritive functional circle of the mosquito

> the most important effector device, the sting, is built for our blood. However, the mosquito's receptors do not get any signal from our blood; it is the smell of our cutaneous glands that affect them. Cutaneous glands and human blood are connected by the anatomical counter-structure – the human skin – , which, although it is definitely part of the mosquito's functional circle, is nevertheless utterly out of any perceptual reach on the part of the mosquito's organism (von Uexküll 1921: 217).

Although at first glance it may seem the opposite, the presence of non-perceptive counter-structures improves the efficacy of the behavioral modalities of the animal. While perceiving the perceptive marks is under the cognitive control of the organism, and thus subject to error (though the role of error in the Uexküllian theoretical framework is very limited), the action based upon operative carriers is completely blind and automatic. Therefore, it must be pre-integrated into the teleological organization of the animal, or into its building-plan. Uexküll expresses this state like this:

> Whether it refers to an inanimate object or to a living being, this "counter-structure" always belongs to the subject's building-plan. This fact alone ensures the presence in nature of a general *correspondence to a plan* [*Planmäßigkeit*], which includes subjects and objects in equal measure (von Uexküll 1921: 46).

[4] In *A Foray into the Worlds of Animals and Humans*, the *Wirkungsträger* become "effect-mark carriers" (*Wirkmalträger*) (von Uexküll 2010: 48).

The notion of functional circle is not entirely comprehensible if its link with the animal's inner world is not discerned. As we have seen, even though Uexküll is far from attributing a psyche in the strictest of senses to animals, he does not refuse inquiry into the functions of sense organs and the central nervous system – and he refers to this physiological sphere when he uses the expression inner world.

In the second edition of *Umwelt und Innenwelt der Tiere*, research into the inner world brings forth two main results. On one hand, the organism must have a perceptive network (*Merknetz)* made of nerves, capable of receiving stimuli and transforming them into quanta of excitation which can act upon the centers of the central nervous system (according to Uexküll, stimulus is originally devoid of any qualitative characteristic able to recall the object itself). As seen previously, excitation in itself is undifferentiated, and the diversity of the response it triggers depends solely on quantitative factors (threshold value) and positional factors (the nerve fibers utilized). On the other hand, the organism also has an operative network (*Wirkungsnetz*), that is to say a separate system of nerve fibers which connects the effector organs to the central nervous system. In other words, Uexküll believes that the split between the perceptive sphere and the operative sphere is also recreated within the organism, and consequently the coherency and efficacy of the action do not come under cognitive control of the animal. If the stimulus loses all reference to the object, in fact, only the overall coherency of the animal/environment system can assure, for example, that a behavioral act invests the proper object from which the stimulus derives. And such a coherency depends solely and fundamentally on the building-plan.

In short, Uexküll writes,

> in any action subject and object are linked by a closed chain of cause and effect. This chain starts from the objects' perceptive mark carriers, in the form of one or more stimuli that affect the animal's receptors. In the animal, the latter are connected in the perceptive network, and then have an effect on the operative one. The operative network transmits to the effector organs a certain motor modality, which becomes part of the operative carriers of the object. The perceptive mark carriers are connected to the operative carriers by the counter-structure. This is how the circle I defined "functional circle" is closed (von Uexküll 1921: 46).

It is opportune to linger for a moment on three particularly significant aspects of the explicative model represented by the functional circle. First, it is important to underline the highly elevated selectivity of the organism towards the stimuli that can initiate a functional circle: "The receptors' task" – Uexküll writes – "is not only to take in certain stimuli, but also to block all the other ones" (von Uexküll 1921: 46). Only in this way can the paucity of certain animal environments be explained – even if it is a relative paucity, because every species has access to the exact stimuli and object characteristics that it needs.

Second, Uexküll does not propose the concept of functional circle as a generic substitute for the reflex behavior: the functional circle, unlike the behavior reflex, is not a sort of empty shape that is presumably valid for every kind of behavioral modality. Rather, the functional circle is highly differentiable: once its structure has been defined in the terms above, it manifests itself in the concrete life of animals in

an extraordinary variety of ways, which Uexküll investigates with great interest. The main result of this investigation is the identification of *primary functional circles*, such as "the prey circle, the enemy circle, the reproductive circle, the medium circle [which allows locomotion]" (von Uexküll 1921: 46). These are clearly distinct from one another: an animal engaged in a behavioral act that falls under the reproductive circle, for example, could be completely closed to stimuli coming from objects belonging to the prey circle, and so forth.[5] The series of functional circles also represent the chronological framework, the *temporal articulation* of the animal's life cycle; it is simultaneously the passing by of life phases – each with its own particular intra-organic conditions (birth, growth, reproduction, death) – and an alternating of environments and perceptive worlds.

Third, according to Uexküll the specific sequence of perceptions and actions that make up a single functional circle necessarily ends with the disappearance of the object from the animal's environment. Although this may be accompanied by the effective elimination of the object (such as nutrition, in which the object is physically consumed), such a disappearance is primarily understood as a cognitive event. As Uexküll states:

> Since the receptors' sensitiveness to stimuli depends on the crossing of an inner threshold, it could happen that the same stimulus, for example that of the prey, becomes inferior after satiation is reached, and makes the object vanish from the environment. In the reproductive functional circle, this "switching off" modality of the object has a crucial role (von Uexküll 1921: 47).

The Uexküllian thesis for which at the end of every single functional circle the relevant objects – or at least their felt components – "turn off" in the mind of the animal shall influence later research on animal behavior. In fact, it could be find in the expression *consummatory action*, which ethologists use to designate the final phase of an instinctive motor sequence. In the *consummatory action* the object from which the stimuli were triggered exhausts its role and vanishes from the environment – physically or "only" cognitively. This action is usually rigid and stereotyped (while the prior phases of the sequences, those of exploration and searching, are more flexible) and it is also followed by a stasis in which the animal ignores stimuli that fall into the same typology of those that have just disappeared.[6]

The Uexküllian (and ethological) hypothesis of the disappearance of the object at the end of a functional circle has a significantly relevant consequence. It brings us to exclude that, at least in terms of instinctive behavior, the animal has a memory at its disposal that is analogous to that of a human: every functional circle is, in

[5] In Uexküll's work, the first appearance (although under a different denomination) of the distinction among different functional circles can already be found in *Leitfaden in das Studium der experimentellen Biologie der Wassertiere*, where he sets forth the idea of "separate perception organs" assigned to the carrying out of different biological functions (von Uexküll 1905: 32). This distinction will later hold significant importance, not only in Uexküll's work, but also, as we shall see, in the use of this term in the works of Lorenz (cf. *below*, 217).

[6] The expression *consummatory action*, attributed to Craig, will enter into common use in ethology with Lorenz; cf. for example Lorenz (1981): 5, 195, 298; Craig 1918.

fact, disconnected from the others, even when it invests objects of the same type or even the same objects. This not only precludes any so-called transversal learning (that is to say based on multiple functional circles), but also hinders the animal from individually recognizing the conspecifics that appear in multiple functional circles (in social animals, for example, the same individual may appear without being recognized first in the functional circle of the parental relation, and then in the hierarchical relation's one).[7]

5.2 The Human Observer's Environment

Besides the replacement of the chapter on reflex with that on the functional circle, the second edition of *Umwelt und Innenwelt der Tiere* differs from the 1909 edition in terms of its concluding chapter; despite keeping the same title ("The observer") and dealing with the same topic (the relation of the human observer with animal environments), it is in fact profoundly re-elaborated.

In the 1909 edition, Uexküll had set forth the fascinating thesis that the environment of higher animals includes the environment of lower animals within itself:

> The more the inner word [of animals] is enriched by the elaboration of such structures, [neural networks, object schemata etc.], the greater and richer will be the environment of the animals. Therefore, the environment of the next higher one includes again and again the environment of the next lower one. And if one imagines the animals as observers, then each time the environment [Umwelt] of the higher animal can be considered to be the surrounding [*Umgebung*] of the lower animal, in which it is observed by the first. The lower animal, together with its environment, presents itself to the observer as a closed unit, whereas the unity of the higher animal with its environment can never be grasped by the lower animal. This conception of the animal kingdoms creates the notion of ever greater circles each enclosing the next smaller one (von Uexküll 1909: 252).

As far as the human observer is concerned, Uexküll believes that he has access to a much wider circle, which coincides with the physical context that is common to all animal environments. To be more specific, in its maximum breadth the environment of man coincides with the world as it is seen by science. In the scientific vision of the world (often thanks to the instruments conceived of by researchers) many elements of the animals' Umwelten which are inaccessible to the natural endowments of man as well as those traits that are not felt by any natural living subject can become objects of study.

Uexküll views the environments of animals and of man as a series of concentric circles, all enclosed in a wider one: the environment of science. This concept, however, implies the possibility that even the scientific environment of man may be the felt part of a larger circle, a species-specific environment "cut out" in a

[7] As we shall see, this problem will be studied by Lorenz – with ample use of Uexküllian categories – in his article *Companions as factor in the bird's environment* (Lorenz 1935).

higher level context, which itself remains unknown. This dynamic is surely active on an intraspecific level: "Us men," – Uexküll notes – "we also live in one another's environments. We undoubtedly live, with our entire environment, in the environment of other men as if we were in a foreign environment" (von Uexküll 1909: 252). But this can be asserted in an even more radical manner: it is completely consistent here to hypothesize that the unfelt context that includes the Umwelt of man could be the environment of a higher being, which Uexküll does not qualify further.[8] Moreover, if we put ourselves in the perspective of man who lives in a superior level environment (a scientific one, for example) then to our eyes the environment of other men cannot help but present notable gaps, due to the paucity of the cognitive instruments and, primarily, to the absence of object schemata adequate to grasp the environmental realities of a superior order.

According to Uexküll the existence of a reality that goes beyond the human faculty of intuition – note here the intentional use of the Kantian term *Anschauung* – is undeniable. Among such realities, life understood in its whole comes into play: our experience necessarily proceeds from the present instant to the next one, and cannot disregard a transcendental structure centered on space and time (which thus establish two fundamental elements of our environment). For the individual rational subject, the phenomenon, including life, is always conditioned; what goes beyond these limits (the noumenon) can be a regulative ideal, but not an object of the environment: "For such higher realities" – Uexküll states Kantianly – "the object has not yet been constituted" (von Uexküll 1909: 252). In the terminology used and in its general tone, the conclusion of the first edition of *Umwelt und Innenwelt der Tiere* has a sharply critical value (and this term, too, should be understood in its Kantian sense) towards the attempts to know completely the vital dimension that makes up our environment as human beings: "As we usually call this superior context 'life'" – Uexküll writes – "[we must admit] that the question of life cannot but escape our blind eyes" (von Uexküll 1909: 252).[9]

Let us move on to the second edition of *Umwelt und Innenwelt der Tiere*, in order to see what changes in the position that Uexküll assigns to the human observer. The rewriting of the conclusion first brings out the disappearance of the articulate gnoseological and epistemological reflections mentioned above; they are replaced

[8] On Uexküll's concept of God see the review by Uexküll of Chamberlain's *Mensch und Gott* [*Man and God*]; after having reaffirmed the unfathomableness of everything which is beyond the sensible experience (reread as environmental experience) of man, Uexküll assigns Plato and Jesus the status of "visionary" explorers of the sphere that precedes and follows the sensible life of man. More than the problem of the existence of God, however, Uexküll's review focuses on the fear that modernity could lose the sense of the divine, and this is what leads to the hegemony of the mechanistic vision of man and of nature (von Uexküll 1922; Chamberlain 1921).

[9] If we substitute the term *life* with that of *world*, Uexküll's reflections seem to come straight from the pages where, in "Transcendental dialectic" of *Critique of Pure Reason*, Kant criticizes the idea of the world (Kant 1999: 460–466); but there are also clear, perceptible echoes of the Kantian evaluation of biology as is expressed in *Critique of the Power of Judgment*, with its underlining of epistemological limits inherent in any inquiry into living beings (Kant 2000: 271).

by an exposition of the key points of the Uexküllian biological and environmental conception. What comes forth is an effective synthesis of his conception in the forms it has assumed in the ten years following the first edition. In this new context, the main task of the "observing biologists" is to liberate themselves from the often unconscious assumption that the human environment coincides in its fundamental structures with the environment of other animals, and rather to search for "which elements serve as perceptive marks for animals" (von Uexküll 1921: 217).

Secondly, and consistently with the central importance the functional circle assumed, biologists are assigned the task of understanding if "the characteristics of its world that the animals' effectors interact with are present only in the animal's operative world (*Wirkungswelt*) or in its perceptive world (*Merkwelt*) as well" (von Uexküll 1921: 217). The comprehension of the environment of an animal species – of its "ecology" to use a more modern term – follows from an analytical understanding of single functional circles that make up the life of its members: movement in space, predation or nutrition, fight or flight, social life and reproductive behavior.

We believe it opportune to quote the most significant of the 21 summarizing points that replace the conclusion of the second edition of *Umwelt und Innenwelt der Tiere*, for their meaningfulness and ability to synthesize Uexküll's ideas.

1. Every animal is the heart of its environment, towards which it places itself as an autonomous subject.
2. The environment of every animal can be divided in an operative world and a perceptive world, which are unified as a whole in the animal's inner world.
3. In every animal's environment there are only things that belong exclusively to that animal.[. . .]
4. The animal's functional circles start from the objects' perceptible properties, expand within the interior bodily world and return to the object through the effector [organs]. [. . .]

10. As soon as they come into action, functional circles become a mechanism closed in itself, which also includes the counter-structure [of the object].
11. The activity of every single functional circle ends with wiping out of the *Umwelt* the perceptive mark carriers. [. . .]

13. Every environment of an animal is a well-outlined part of the world as it appears to an observer, both in space and time, as well as in its contents.
14. The observer can recognize the perceptive marks that affect an animal only as a property of the world that appears to him, which its sensations reflect. The sensations of the animals always elude him.
15. Every animal carries within itself its own environment like an invisible shell.
16. The same is true for the world as it appears to an observer; in this case too, it is his environment and separates him completely from the universe. [. . .]

19. The world as it appears to each and every human being is also like a solid shell that surrounds them continuously from birth to death.
20. The appearance and disappearance of these worlds is the ultimate problem science tends towards with infallible certainty.
21. Regarding the laws that create and destroy life, we can only say that they are based on an omnicomprehensive finality, which shows itself best in the insertion [*Einpassung*] of every living being in its environment (von Uexküll 1921: 218–219).

In contrast to the conclusion of the first edition of *Umwelt und Innenwelt der Tiere*, dominated by prudence and a sense of limitation typical of a Kantian-oriented epistemology, a more optimistic tone prevails in the second edition (see in point 20 the "infallible certainty" of biological science). This greater trust perhaps depends on how productive the notion of the functional circle is, which will be fully developed in later works. But, as we have seen, Uexküll's overall theoretical construction acquires greater stability even thanks to his abandoning of the concept of *Gegenwelt*; this concept was founded on the problematic and hardly verifiable hypothesis of an exact correspondence between the networks of the central nervous system and the forms of the external world. In their entirety, these changes in the Uexküllian conception foreshadow the semiotic vision of relationships between the organism and the exterior reality that would be developed in *Theoretische Biologie* and would find its fullest expression in *A Foray into the Worlds of Animals and Humans* and in *A Theory of Meaning*.

5.3 The Foundation of Theoretical Biology

The most systematic and ambitious of Uexküll's writings is *Theoretische Biologie,*[10] where he attempts not only to recapitulate and order the foundations of his conception of life, but also to confront the themes and new discoveries in biology at his time. In particular, without withdrawing from his refusal towards the theoretical framework of evolutionism, Uexküll attempts to integrate certain significant elements such as Mendel's law or the early discoveries in the field of genetics into his theoretical biology. Though *Theoretische Biologie* does not claim to be exhaustive on the level of specialized knowledge, it is written to serve as a comprehensive summary of the models, methods and areas of study which were predominant in biology in the early twentieth century.

5.3.1 Signs in the Environment: The Transcendental Biosemiotics of Uexküll

As in the previous works, in *Theoretische Biologie* we also find the evident desire on Uexküll's part to add inquiry into the theoretical suppositions of biology in a Kantian frame. The idea of providing a transcendental layout to biological research becomes a sort of test-bed which allows for the evaluation of the work

[10]Three German editions of this work exist: the first dated 1920 (von Uexküll 1920), the second, re-elaborated, dated 1928 (von Uexküll 1928) and a reprinting in 1973 (von Uexküll 1973). Because the nature of the modifications in the second edition do not justify a comparative analysis with the first (as instead is the case with *Umwelt und Innenwelt der Tiere*), our work is based exclusively on the second edition.

of physiologists, biologists, zoologists, and even scholars of animal psychology. As we shall see, this type of evaluation is not only destructive: the compatibility with his own "amplified Kantism" allows Uexküll to identify what he believes to be the most valid contributions in each of these disciplines.

For Uexküll, among the most significant contributions in terms of the definition of theoretical biology comes from Helmholtz (cf. *above*, 23), whom he defines as a "genius physician of physiological psychology" (von Uexküll 1928: 1). According to Uexküll, Helmholtz's principal theoretical acquisition consists in having reduced the contents of animal perception to *sensory qualities*, or rather indivisible and unitary units that are devoid of superior objectual properties and can vary only in terms of intensity. The most relevant aspect of Helmholtz's idea is that such qualities are "signs of an external event, and their alterations flow parallel to it. This external event remains unknown to us" (von Uexküll 1928: 2). The strong agreement between this conception of animal perception and Uexküll's is evident; it, too, is centered upon the idea that sensory stimuli are *signs* of an external reality, which is ultimately unknowable, and are not linked to the latter in any sort of mimetic or representative relationship.

At the same time, however, Uexküll rebukes Helmholtz for letting himself be led by these same presuppositions to an extreme subjectivism: nothing in fact guarantees that sensory qualities are the same for all perceiving subjects, not even within the same biological species. As Uexküll suggests, it is not surprising that, for Helmholtz, the principle of the uniformity of nature is reduced to a dogma of faith; in other words, in Helmholtz, the relativism of the experience of single subjects necessarily brings about the idea that the existence of natural laws which are universally valid is an object of faith, and not a hypothesis to be verified.

Uexküll's solution to the problem of potential interpretative differences of subjects placed in front of signs coming from external reality consists in reaffirming the Kantian position of the universality of the transcendental structures – a universality that, in the Uexküllian context of a systematic extension to non-human subjects of the Kantian approach, will be, however, species-specific, and not exclusive to rational beings. In other words, if the constitution of environmental elements beginning with sensory material (from sensory qualities, to use Helmholtz's term) depends on a priori principles and transcendental schemata which the subjects possess, and if (Kantianly) such shapes are constant for the various typologies of the subjects (for the various biological species), then we should no longer fear falling into relativism of experience. Or, to be more precise, environmental experience will be universal within a species and simultaneously variable on the inter-specific level.

Uexküll writes, therefore, that it is not a question of abandoning the fundamental principle for which "the whole reality is a subjective appearance [*Erscheinung*]", but rather to make it "the vast knowledge background underlying biology too" (von Uexküll 1928: 2). In particular, Uexküll writes,

> The task of biology is to expand the outcome of Kant's research in two directions: i. to take into account the role of our body too, in particular of our sense organs and central nervous system, and ii. to investigate the relationships with the objects of the other subjects (animals) (von Uexküll 1928: 3)

Let us focus on the first of the two directions for expansion indicated in the above quote (keeping in mind that it is restricted to the field of animals endowed with a central nervous system). According to Uexküll, in his theory of consciousness Kant seems to have neglected the a priori forms of perception – whose significance Uexküll instead held to be "enormous" – and limited himself to levels of intuition and of intellect. In Kant's analysis, the forms of sensible intuition (space and time) do not seem to be further reducible to other a priori principles. Yet, Uexküll writes, in the biological perspective, space and time must be differentiated not only according to the biological species of the perceiving subject, but also according to the particular sense that is being considered, or rather the particular sensory qualities that are to be organized.

The first three chapters of *Theoretische Biologie* are dedicated to filling this gap. They propose a biological analysis of the forms of sensible intuition that is intended to put them in a light which, on one side, shows their dependency of the corporeal reality of the subject and on the other, their species-specificity. This strategy of expanding the Kantian approach brings Uexküll to attribute the status of a priori reality not only to *forms* of the sensible consciousness (space and time) but also to certain *elementary contents* of sensory experience. These consist in "specific properties" (von Uexküll 1928: 5), either spatial or temporal, which are also empirically identifiable but simultaneously independent from the sensory stimuli each time they are perceived.

Let us start with the spatial qualities, which Uexküll also defines as "local signs" (*Lokalzeichen*). These consist in the particular *coloring* of the spatial context in which we place a certain perception, a coloring which allows us to mark certain specific, a priori existing places within the perceptive sphere of the subject. Besides being closely dependent on the body of the subject, Uexküll believes the local marks differ from sense to sense; in terms of sight, for example, the local coloring of a perception depends on which of the sensory cells of the eye (cones or rods) have been stimulated in the specific case. The location of the perceived stimulus in the environment – for it is clear that here, from a different perspective, Uexküll is deepening his conception of the Umwelt – is thus a result of an "outward transposition [*Hinausverlegung*]"[11] of qualities emerging from the

[11]One of the passages in which the idea of the outward transposition of sensations is expressed most clearly is found in the article *Psychologie und Biologie in ihrer Stellung zur Tierseele*, in which Uexküll declares that he "places himself without reserve on the ground of [kantian] transcendental idealism" and states: "All that belongs to intuition is immediately, and without our help, conveyed to the outside; and it is this transfer to the outside that, from his point of view, gives us the confirmation that we are dealing with [the faculty of] intuition. [...] Kant calls the overall sum of sensations transferred to the outside (the phenomena) sensitivity. [...] Finally, we transform these complex orders of phenomena into objects in space. This [...] phase of the global process of apperception, the configuration of the groups of phenomena in objects, deserves our special attention" (von Uexküll 1902: 216–217). As we have seen, the process of the constitution of environmental elements does not arrive in all animals at configuring objects, while the outward transposition of sensations (or rather the formation of phenomenal worlds) is a universal phenomenon: "Just as we base our world on our perceptive marks and, thanks to them,

encounter between the stimulus itself and the subjective substrate represented by the forms prior to perception. The possibility to distinguish a priori among many different local qualities allows us to create for all senses a system of coordinates capable of connecting the body/subject to different stimulations, arranging them around in a coherent and efficient manner.

But let us move one step further. When stimulation travels from one portion to another of the receptive tissue of a sense organ, the excitatory process is accompanied by a quality (or coloring, or sign): the direction. Independently from personal experiences, human beings distinguish four *directional qualities*: towards the left, towards the right, upwards, and downwards.[12] Just like local signs, directional qualities are also experienced as object properties of the environment:

> Like the quality of local signs, which becomes a property of the environment once it is transferred to the outside, and is named "place", the quality of directional signs becomes a *step* in the environment when it is transferred to the outside (von Uexküll 1928: 12).

The directional qualities graft on to the static structure created by the local signs a dynamic environment experience. As already described in the second edition of *Umwelt und Innenwelt der Tiere*, Uexküll subdivides this experience into two different spheres (which is consistent with the distinction between the perceptive and the operative world): the reperception of movements taking place in the environment and the projection in the environment of possible movements of the subject. What Uexküll defined in the last passage as "steps in the environment" thus take on two forms: they are *perceptive steps (Merkschritte)* if they consist in the outward transposition of a directional signal that does not concern the subject but rather external reality, and *operative steps (Wirkschritte)* if they transpose in the environment a directional signal which involves the subject (on an effective or a planning level). It is clear that, in the second case, the stimulation of the perceptive tissue which originates the directional signal must have an intra-organic origin: "The operative steps are related to the innervation of the ocular muscles, which derives from an impulse of our own will" (von Uexküll 1928: 14). This is possible because,

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give it shape and color, it is in the same way that any subject bases its own world upon its own perceptive marks, which it transfers to the outside, thus turning them into just as many properties of its world. This is not only true for other human beings, with their world similar to ours, but also for animals, with their worlds differing from ours in more ways than one" (von Uexküll 1930: 127).

[12]In terms of the constitution of space, Uexküll writes: "[We should underline the fact] that we have the ability to color our space. Depending on the coloring of tactile or visual surfaces, we can divide our space of action in colored halves, respectively according to the right-left, top-bottom, front-back oppositions. The three border surfaces of the space segments colored in this way [. . .] establish a system of coordinates" (von Uexküll 1928: 18). From an anatomical point of view, the intra-organic precondition of this system of coordinates (then transposed into the environment) consists in the presence of semi-circular canals in the ear; such a system is thus a transcendental element only in the environment of some species (von Uexküll 1928: 19). In regards to this, Uexküll's observation here is interesting in that "we will transfer in space a system of coordinates, which is not only thought out, but also felt" (von Uexküll 1928: 18). In this observation we find an implicit critique of the intellectualism of the Kantian approach.

without being aware of it, even the movements of the different muscular bundles (whether these are only hinted at or completely expressed) are associated to the local and directional qualities transposable in the external environment (von Uexküll 1928: 22).

As one can deduce from the quote above, a new element comes into play in the analyses of operative steps, that of the will of the organism, which will have a central importance in the Uexküllian theory of animal action (also formulated in *Theoretische Biologie*). In the overall framework of Uexküllian biology, the will is an instance which is functionally analogous to the *Naturfaktor* from his previous works. It is, therefore, a typically vitalistic notion: it is immaterial and impossible to investigate, and acts in a teleological and impersonal sense, explaining the vital phenomena which remain unexplainable to a mechanist approach (such as the spontaneity of the acting organism, which does not limit itself to reacting to external stimuli).

Let us return to the constitution of the subjective environment as described in *Theoretische Biologie*. Through the operative steps, the will of the subject (it be human or animal) reveals an operative space (*Wirkraum*) around it interwoven with all the behavioral possibilities belonging to its species. These possibilities derive from "hints" of muscular movement based on self-produced directional signs, which on a subjective plane, however, are experienced as qualities of the environment (or better: as *possible lines of action triggered by qualities of the environment*). Among these operative spaces of animal subjects, Uexküll mentions the bees' "space of flight", of which man – lacking in corresponding sense organs, antennae in this case – can only have a vague idea.

Taking a deeper look at a number of intuitions which were already present in prior works, Uexküll sees the relationship between subject and external world as a process of elaboration and outward transposition of signs, a process whose result is the environment. It would not be an exaggeration to speak about a true *transcendental biosemiotics* in these regards, albeit with a warning that, for Uexküll, environmental signs are not linked with an independent reality by any sort of denotative relation, but are *constitutive*. In other words, from the subject's perspective, the relationship with the environment is sketched out as an *interpretative relation*. It is nevertheless clear that we are dealing with quite a particular type of interpretation, insomuch as the organism never has the possibility to check the validity of the interpretation – or rather the real correspondence between the transcendental species-specific structures and the external reality. Moreover, because Uexküll refutes the theory of natural selection, one cannot hypothesize that it is the environment itself that is exercising a controlling function on the a priori cognitive structures, selecting the individuals who possess the most advantageous ones and eliminating those who are cognitively disadvantaged.

As he did with space, Uexküll attempts to identify a number of transcendental coordinates even for time; in other words, to retrace the *temporal qualities* in the environment that, despite being transcendental, are not merely formal but rather establish fixed points onto which the lived experience of individual members of a species can be constructed. To this purpose Uexküll makes an observation which

allows us to understand his intention, which is very close to the inspiration of philosophical anthropology in the twentieth century of research into an *a priori* material:

> The progress we made over Kant's doctrine consists in identifying specific spatial qualities (spatial and directional signs) and in acknowledging the fact that space is the shape of its own matter, as the tone scale is the shape of its specific matter, notes. [We should therefore aim at the] discovery for a specific matter for time (von Uexküll 1928: 44).

Thus – following the terminology of von Baer, who had defined as the "moments" the different qualities of time understood as subjective experience – Uexküll introduces the term of "moment signs [*Momentzeichen*]" (von Uexküll 1928: 44) into his biosemiotics. Moment signs are based upon a specific coloring which distinguishes the different phases of our subjective experience; they allow us to delimit some temporal units from within its duration. Just as with local signs, moment signs also primarily function to "color" or mark different points of the correspondent pure form of intuition.

But their usefulness fully emerges when they form syntheses with another kind of a priori environmental element, what Uexküll defines as *content-qualities* (von Uexküll 1928: 60); these qualities are "circles of qualities", or *classes of contents* such as shape, color, temperature, solidity, etc. Every temporal sign (though the same is true for local signs) can be accompanied by a single property for each circle, with respect to the principle of non-contradiction: "Every place can only contain one quality for each circle of qualities. A certain place can be blue-green, but not blue and green at the same time. It can be mildly hard, but not hard and soft at the same time" (von Uexküll 1928: 61).

Even the content-qualities are species-specific: the possibility for their emergence in the environment depends on the building-plan of the organism. The environment of the animal subject will thus be open to a predefined number of classes of content; in other words, there may be environments in which the content-quality of color is completely missing (the environment of the mole, for example), but in which the spatial and temporal signs are accompanied by an intense tactile quality.

Following this content-related expansion of the transcendental Kantian approach, the concrete environmental experience – what Uexküll defines as the "lived moment [*erlebter Moment*]" (von Uexküll 1928: 45)[13] – is the final product of the encounter between two elements: the formal a priori (space and time in a Kantian meaning) and the material a priori (local and temporal signs, directional signs, content-qualities). Uexküll summarizes this dynamic model in the following way:

> [Unlike in physics], the biologist claims that there are as many worlds as there are subjects and that these worlds are phenomenal worlds [*Erscheinungswelten*] which can only be understood in relation to the subjects. The subjective worlds consist of: 1. places, whose

[13]We find an ambiguity in the transcendental subject model established by Uexküll: if, in relation to the content-qualities the local and temporal signs seem to be forms, in relation to pure Kantian forms they have instead the status of contents.

> number is limited; 2. movements, whose scope is limited; 3. moments, whose sequence has a beginning and an end, and 4. content-qualities, whose number is also fixed (von Uexküll 1928: 61).[14]

Using a musical metaphor, Uexküll describes the relation that runs between the formal elements and material elements coming into play in the transcendental constitution of animal environments in the following way.

> We must [. . .] expand Kant's doctrine and accept that there are forms for every type of quality, which are completely a priori, precede any experience and grant to each quality, as soon as it appear, a special spot within a system. The neglect of the a priori shapes of the content qualities is partly due to the fact that they do not possess a name of their own, unlike space and time. Only the metaphorical designation "tone scale" is familiar (to indicate the sequence of tones); following that example we can also speak of "chromatic scale", "olfactory scale", etc. [. . .] But we are compelled to expand Kant's theory on another point too. Not only does every qualitative material have fixed forms, but also the number of single qualities within the corresponding shape is given in the absolute, prior to any experience (von Uexküll 1928: 61).

According to this and other laws, from unformed subjective material sensations become concrete properties of the external world and objects. This fundamental principle does not allow for infractions: what appears to us as the objective world is, in fact, the product of the interaction among multiple a priori structures of the subject on one hand, and on the other, isolated sensations coming from an unknown external reality, which are allowed to "enter" into the same transcendental forms.

Here we encounter a problem of enormous importance, not only in terms of the comprehension of the theoretical biology of Uexküll but also, and more importantly, for its critical evaluation: what is the source of the agreement between a priori elements (local and temporal signs, directional signs, content-qualities) and the external reality? In other words: how do we explain, for example, that a self-produced directional sign, once it has been re-transposed in the environment, comes to "agree" with the unelaborated, "bare" stimuli which come from the extra-organic reality? In the model set out in *Theoretische Biologie*, the final root of this agreement between organism and external reality seems to lie in the fact that both the perceptive sphere and the operative one derive from the subject's activity, who transposes *perceptive steps* as well as *operative steps* into the environment. However, this only shifts our problem from one place to another: we are not, in fact, dealing with explaining the coordination between perception and action, but the agreement between such spheres of activity and external reality – in Kantian terms, between the a priori (although it is enriched by material elements) and the noumenon in its existence that is independent from the subject. Moreover, since

[14]The presence of the pure intuitions of space and time is required by the material a priori, which otherwise would not make sense: without time – understood as the general form of "one after another" – the moment signs would not even be placeable in a series, and the environmental experience would be made up of segments or unrelated points. This obviously does not mean that the pure forms of space and time must be included into the felt, or reperceived, experience of the organisms.

Uexküll acknowledges the species-specificity of the transcendental constitution of the environment, it is necessary to give reasons to the agreement that exists among the environments of different biological species.[15]

Explicative recourse to the will only aggravates this critical point, which is present in the background of all of Uexküll's works and to which we shall return. As we have seen, the will is the ultimate source of endogenous stimulation – which is then translated into (real or imaginary) "steps" projected into the operative space. If this is true, however, then the subject's capacity for action comes to depend on blind and impersonal dynamics, held up by an overall finality which is able to connect it with external reality, but at the same time makes that external reality remote and inaccessible. In short, in order to explain the coherency between the a priori structures of organisms and reality, and overall the correspondence among the impulses of the will and the "steps" in the environment in which these are translated, Uexküll cannot help but reaffirm the efficacious action of the natural factor which, from his first works, has represented the super-mechanical and unknowable element of life: "Here we come up against a natural factor within us, which – even though it is integrated in a planned way in the activity of our mind – remains unknowable" (von Uexküll 1928: 22). The incompatibility of this response and the modern scientific mentality has been noted several times.

This incompatibility is accentuated by Uexküll's fixism, i.e. by his conviction that every characteristic of animal species, including the transcendental structures directed towards the constitution of the environment, are predefined and unchangeable. It is important to note how this rigid tie between transcendental subject and environment brings about two closely-linked consequences. On one hand, it allows for great variety in species-specific environment-worlds (which can differ not only according to the a priori forms which constitute them, but also according to the contents that can enter into any form). On the other, it excludes any and all direct access to the environment of other species – and this also goes for the human observer. It is, in fact, necessary to keep in mind that environmental components cannot be "perceived differently" by the observer. Whether it is a part of his own environment or a component of the environment of another organism, the human observer cannot help but see a red surface as red – and this is because, in its "transcendental syntax", that local sign is assigned a single content-quality of the class "color". What the human observer can attempt to do is understand deductively – that is to say through the study of physiology and the observation of behavior – if said object is more or less relevant in the environment of an animal (meaning whether or not it enters into one of its functional circles). Generalizing, Uexküll writes "the observer's main task is to ascertain, out of all the qualities, the number and type of those that appear to be perceptive marks in the animal's environment", and in understanding in what way they can act as supports for the action of the organism being studied (von Uexküll 1928: 61).

[15]For agreement among species we do not necessarily mean peace or harmony: nothing is more important for a predator than to move in the very same spatial-temporal context as its prey.

Starting from the transcendental analysis of the environment-worlds of man and animals, at the end of the first three chapters of *Theoretische Biologie*, Uexküll returns to the fundamental theses he made in the second edition of *Umwelt und Innenwelt der Tiere,* i.e. to the subdivision of the environment into a perceptive world (*Merkwelt*) and an operative world (*Wirkwelt*) and to the importance of functional circles in which the concrete acts of perception and action are carried out. These theses, however, are inserted into an entirely new context in which two features assume central value: the constitutive function of the animal consciousness towards the environment and the interpretative relation that runs between the animal (understood as the subject of action) and the different signs which make up its environment. In conclusion, it appears appropriate to repeat that this interpretative relation – which for the Uexküllian conception justifies the use of the term biosemiotics – has some particularly interesting traits: the signs that the animal interprets are a product of the "transposing" action of the consciousness, and do not have any denotative (or much less mimetic) relation with the external reality in the sense of traditional logic and semiotics.

5.3.2 Towards a Theory of Animal Action

In consonance with the author's neovitalist and teleological background, *Theoretische Biologie* introduces a significant innovation in comparison with previous works: the elaboration of an articulated theory on animal action. This theory is the result of a reasoned classification of animal behavioral modalities: starting from the most elementary forms of behavior, reflex action (*Reflexhandlung*), Uexküll arrives at what he considers the most complex, which is controlled action (*kontrollierte Handlung*). Between the two extremes, there are four intermediate modalities: formative action (*Formhandlung*), instinctive action (*Instinkthandlung*), plastic action (*plastische Handlung*) and action based on experience (*Erfahrungshandlung*).

Before describing the most relevant of these behavioral modalities in detail, it is necessary to give further indications on the classification criteria Uexküll adopts. Firstly, the connection among the different behavioral modalities is not evolutive: in the Uexküllian conception, the behavioral repertoire of organisms – just like with the physiological and morphological characteristics – is an integral part of the species-specific building-plan. Among the building-plans of different species, no direct connection is contemplated (let alone a connection based on the spontaneous transformation of less complex forms into more complex ones). Moreover, in *Theoretische Biologie*, Uexküll also reaffirms that the building-plan is excluded from direct empirical inquiry: "We do not know anything about the way building-plans act on matter as immaterial factors; all we can say is, in general, that they emit impulses, which in turn affect matter" (von Uexküll 1928: 205).

In the absence of a genealogical or evolutive connection, the classification of the forms of action proposed by Uexküll must necessarily derive from elements within his philosophy of the living; specifically, from the theory of functional circles. To

this end, Uexküll gives a preliminary definition of action: action is the part of the functional circle that is carried out in the body of the animal from the moment of stimulus reception to the moment of the activation of an effector organ. In more detail, the elements involved in the action are the following: receptor – perceptive organ –action organ – effector; for these elements, Uexküll suggests the abbreviation of R – PO – AO – E. In order to avoid misunderstandings, it is important to specify that while the receptors and the effectors are exterior corporeal components (the sense organs, the limbs), with the terms "perceptive organ" and "center of action" Uexküll designs the components of the nervous system assigned to the elaboration of sensory data and the production of motor impulses.

Keeping this general schema in mind, let us now go a step further. For Uexküll the possibility to classify different actions depends on the characteristics of the functional circle in which they are inserted; in particular, "we distinguish the various types of action according to whether the functional circles use an already available structure, or whether they need to make a new one using the impulses" sent to the motor organs by the teleological immaterial factor (von Uexküll 1928: 205). Here we note the appearance of an intermediate element among the immaterial factors (namely the will, in terms of the behavioral sphere) and the material elements: *impulses*, a sort of "organizing messengers" aimed at allowing for the best course of biological processes. The diversity and the growing complexity of behavioral modalities, therefore, derive from the difference between the impulses transmitted from the building-plans (behind which hides the will) to the motor organs involved in a determinate functional circle. To make an example: in some organisms, impulses are aimed at the creation of momentary organs (such is the case with the amoeba); in others, they are limited to activating already formed structures.

This conception – which today is scientifically unacceptable for its dependence on the unexplainable teleological factors hidden behind impulses, such as will or *Naturfaktor* – has the merit of avoiding one of the most serious limits that can compromise behavioral theories, that of considering animal action as an immediate reaction to external stimuli. Often the use of such an explicative model appears nearly obligatory, especially for the more elementary modalities of animal behavior such as reflex action and instinctive action. But even at this level, Uexküll explains, considering the stimulus-reaction pair as a paradigmatic modality of behavior brings about an atomistic vision of behavior, in which the overall sense becomes difficult to grasp. In the author's words,

> Also in the case of the simplest and most inevitable action (reflex) [. . .] I don't write down that part of the functional circle taking place in the animal's body [simply] as R –PO – AO – E (receptor – perceptive organ – action organ – effector), but rather as R/I –PO/I – AO/I – E/I, in order to show that all organs depend on the impulses [I] from the functional circle (von Uexküll 1928: 205).

It is necessary here to make a clarification in terms of the graphic conventions adopted by Uexküll in the formulas with which different modalities of animal action are described, and specifically in the way in which he uses the forward slash /. The presence of the slash between two terms of a relation (as in the quote) indicates a

relation of dependence mediated by *fixed* anatomical, physiological or behavioral structures. Its *absence* (and we shall see the cases of EI, AOI, POI) indicates instead a dependency with "open" modalities, which translates into the immediate creation of corporeal structures (as is the case of the amoeba), of behavior modalities, etc.

If we return now to the schema that Uexküll proposed for reflex action (R/I – PO/I – AO/I – E/I). Emphasizing the intervention of the impulses at each point, which may seem redundant, has a very specific aim. It aims to remove from reflex action that automatism which, as in Pavlov and in American behaviorists, could by extension bring about the conception of the entirety of animal behavior as the functioning of "a machine lacking a control center" (von Uexküll 1928: 206) – with the result that behavior is dissolved into isolated sequences and its overall finality is lost.

Once it has been "enriched" by the effective presence of impulses, the schema of reflex action acts as a base for Uexküll to describe the more elaborate modalities of action. These do not call upon other elements; if they are differentiated from reflex action, it is because in them the impulses intervene on the elements of the pattern with different modalities. In particular, in more complex modalities of action, there are points in which the flow of impulses is more direct and immediate, and it will be on the basis of these points that the modalities shall be classified.

To give an example, in the case of formative action – whose formula is R/I – PO/I – AO/I – EI – the EI component of the schema tells us that the behavioral impulses translate into a direct modification of the effectors. This is, as we know, the distinct trait of some unicellular organisms such as the amoeba, which can form momentary organs (pseudopods) suitable to the current situation.[16]

Without entering into every single modality of action classified by Uexküll, we shall linger on three of them: instinctive action, action based on experience, and controlled action. Instinctive action is different from reflex action for the fact that in it the stimulus triggered is constituted by an environment trait that is reperceived by the organism as a subject. From this increase in "environmental awareness" comes an improved plasticity of action, a plasticity which has its reason for being in the necessity to modify the behavioral modalities, which are fixed per se, according to the external circumstances.[17] In Uexküll's framework

> the plasticity of [instinctive] actions derives only from the fact that animals have a large number of perceptive traits, which allow them to cope with external circumstances within a wide spectrum of modifications. The rhythm of the sequence of actions can thus be modified according to the variety of the perceptive traits (von Uexküll 1928: 207).

It is here evident that Uexküll wishes to distance himself as much as possible from the mechanistic conceptions of instinctive behavior, which (from Descartes

[16]Uexküll again takes up the vitalist interpretation of the formation of the amoeba and the role the protoplasm plays in it; see *above*, 65.

[17]The example cited by Uexküll for this typology is the reproductive behavior of the ichneumon fly (*Megarhyssa macrurus*), which "is influenced by many external perceptive marks" and nonetheless follows a definite species-specific schema (von Uexküll 1928: 207).

on) is frequently seen as rigidly predetermined, often as a sort of concatenation of reflex actions.[18] Remaining consistent with the concept of the functional circle, Uexküll instead highlights how instinctive behavior, too, is a part of the overall environmental situation and must therefore be plastic and modifiable. The schema of instinctive actions will thus be R/I –PO/I – AOI – E/I; the absence of the forward slash in correspondence of action organ (AO) means that the point of most plasticity is not found either in perception, or in the structure of the effector organs (which remain fixed), but rather in the modalities of the uses of the effectors and the physiological dynamics at their base. We must emphasize that the Uexküllian conception of instinct also extends to human beings, in which the instinctive action – far from being seen as a rigid and "primitive" part of the behavioral repertoire – is defined in rather flattering terms: for Uexküll they are "series of movements in accordance with a plan, whose execution shows a certain normativity and whose rhythm adapts to outer circumstances, without being coercive in themselves" (von Uexküll 1928: 208).

Let us now move on to action based on experience, whose formula is R/I – POI – AOI – E/I. The receptive and the effector organs remain fixed, while the organs of perception (PO) and the action organs instead provide an action directed by "impulses" which, teleologically, structure a more complex natural functional circle. In action based on experience, therefore, complexity is further increased. As an example, Uexküll gives the behavior of a bullfinch (*Pyrrhula pyrrhula*) which can imitate a tune played by a man. In this case the behavioral sequence not only adapts to a stimulus constellation which is new both for the individual as well as for the species – in other words, it is not a part of the innate repertoire of the perceptive situations that triggers an action – but it is itself modified according to a new rule, which coincides with the very melody being imitated. This presupposes a cognitive acquisition of enormous importance, that is to say the capacity to treat every single phase of action (or better its perceivable parts, in this case a note) as a perceptive sign capable of orienting the execution of successive phases. If, to repeat Uexküll's example, the bullfinch is kept from hearing its own song, it will be unable to reproduce the melody that it has repeatedly heard.

On an even higher level of complexity, we find controlled action, which is present in higher animals and in its more typical and complete form in man. This typology of action is a sort of enhancement of action based on experience. In this case, feedback, i.e. the retroactive orientation based on the perception of previous phases, does not stop with the end of the learning phase but remains as a lasting possibility.[19] In other words, once the new constellation of stimuli has been established, the controlled

[18]For the conception of the instinct as a chain of reflexes cf. Ziegler 1920. Cf. also the critique that Lorenz makes towards Ziegler in the essay *The Establishment of the Instinct Concept* (Lorenz 1937: 261, 301–303, 305).

[19]According to Uexküll, control of the action through retroactive orientation can occur in two principle modalities: through the perception of perceptive traits outside of the body (as is the case with the bullfinch who hears its own song), and through the perception of one's own muscular movement (proprioceptivity) (von Uexküll 1928: 209).

action is fixed until it achieves a level of stability analogous to that of instinctive action – which never occurs with action based on experience.

The schema of controlled action is R/I – POI ⇄ AOI – E/I. Graphically too, it demonstrates how controlled action introduces into the functional circles "a new circle, [...] [which] connects the operative organ and the receptive one" (von Uexküll 1928: 133). The peculiarity of this type of action consists in the insertion of a *schema of use* of stimuli which is not given a priori in the behavioral repertoire of the species (while, naturally, the possibility to separately perceive individual stimuli which form a new constellation must be a given).

In man, the schemata of use achieve their fullest expression, as demonstrates this example given and experienced by Uexküll himself.

> I remember once [...] that two other researchers and I couldn't see a microscope we were looking for because one of us said he had placed it upright on the table. It wasn't until our assistant, who in the meantime had laid it sideways on the table, pointed to it that we suddenly saw it in front of us. The perceptive signs [*Sinneszeichen*] related to the microscope were not kept from us, we had just associated them with other instruments also on the table" (von Uexküll 1928: 77).[20]

Uexküll uses a musical metaphor to explain the cognitive process that unfolds in this and other similar cases:

> The melody of the perceptive signs that were supposed to form the microscope could not ring, because we wanted to approach its shape only according to the melody of the microscope set upright on the table. But without this melody, the microscope could not be shaped, so it simply was not there. Without the subjective condition of the schema, nothing in the world can exist" (von Uexküll 1928: 77).[21]

In its most complete form the use of schemata aims not only at a new arrangement of perceptive stimuli but also at the understanding of the *function* of the object in which they come together. It is, therefore, truly an "activity rule [*Tätigkeitsregel*]" (von Uexküll 1928: 86) related to the perceived object. From a perceptive point of view we reach here a higher level in the constitution of the environment: if the environment of lower animals is essentially constructed by isolated qualities, that of

[20]As Uexküll states in his articles *Plan und Induktion*, besides through schemata of use in man the functional circle can achieve a level of superior articulation thanks to the insertion of auxiliary mechanisms of technical character. This can happen in two key positions, that is between the receptor and the object and between the effector and the object; in the first case we speak of "perception tools [*Merk-Mittel*]", and in the second "operative tools [*Wirk-Mittel*]" (von Uexküll 1929: 37). Unfortunately, this idea, which could have brought about further reflections on the peculiarity of the perceptive and operative environment of man in comparison with that of animals, is not studied further in Uexküll's main works.

[21]The term "schema" is consciously used by Uexküll in connection not only with Kant but also with Plato: "Following in Plato's footsteps, Kant compares the schema of empirical things with a sort of monogram that was impressed on the soul and that is the starting point of the building process of things as well as of the creating process of imagination" (von Uexküll 1928: 77). On the theoretical problems generated by the presence in the schema of a formal ("Kantian") side and a content-related ("Platonic") one, see *above*, 92–93.

superior animals and man is constructed by cohesive unities, not only from a spatial and temporal point of view, but also from a functional one.[22]

This explanation, which completes the ideas already seen in the second edition of *Umwelt und Innenwelt der Tiere*, deserves greater inquiry. The functional schema overlaps with the objects understood as spatial-temporal perceptive units and it specifies a relation with the subject; with this passage, objects are established as dynamic units which are inserted in a flexible manner in the subject's pre-existing forms of life. Uexküll presents us with a clear example in this regard. During a journey in Africa Uexküll met a young native who was extremely good at climbing trees; when placed in front of a ladder, however, the young man showed no signs of comprehension. As soon as he was shown how to make use of it, thanks to his great agility he learned immediately. "The stable rule of the climbing activity" – Uexküll states – "immediately ordered that muddle of sticks and holes and gave shape to the ladder. Only the knowledge of the corresponding activity or "function" rule can order the parts of a whole" (von Uexküll 1928: 77). Uexküll believes, therefore, that the acquisition of new schemata – whether they be spatial-temporal or functional – is not only the base of the most elevated typologies of action (action based on experience and controlled action), but it is also the base of the richest, most coherent and unitary species-specific environments. A schema is not in fact a mere collection of stimuli but a field of sense transposed into the environment, an ordering nucleus that can link itself to other nuclei in order to build a symbolic framework capable of sustaining the life of an organism in the passages of its functional circles.

To summarize his observations on the concept of schema, Uexküll proposes a general distinction between "animals of instinct" (*Instinkttiere*) like insects and birds, and "animals of experience" (*Erfahrungstiere*), the category in which we find mammals and humans. The difference between these two categories consists in the following:

> [While] the animals moved by instinct possess for the various functions innate sequences of impulses, which unwind without errors and without further control, [on the contrary] in order to build the exact set of impulses necessary to the functions and to gain control over action, the animals moved by experience need schemata (von Uexküll 1928: 94).

This differentiation, which Uexküll hints at but does not examine further, will constitute the base of a large part of future research on animal behavior, which well tend to make clear distinctions between innate action and action based on experience. The concepts of schema, instinct and experience will be central, especially in Lorenz's 1930s works, which are closely linked to the works of Uexküll. However, Lorenz's conception will differ from Uexküll in certain fundamental points; for example, his evolutionist explanation of the origin of schemata and the decisive affirmation that it is possible for instinctive-type motor modules and learned type one to intertwine in a single species or even in a single behavior. With these

[22]Uexküll also distinguishes these two typologies of environmental entities from a terminological point of view: the first includes *Objekte*, the second *Gegenstände*; both terms translate as *objects* in English.

modifications and integrations, one of the fundamental methodological principles of Uexküll's theory of action was to remain relevant in twentieth century ethology: the study of the behavior of a given species cannot be separated from the inquiry into the cognitive constitution of its environment. The transcendental, Kantian approach can and must be completed by less speculative models of empirical research (according to the line of development of current cognitive sciences), but the elaboration of a coherent theory of perceptive, operative and symbolic faculties of living beings remains an indispensable requirement.

5.3.3 Embryogenesis in Theoretische Biologie

Leaving the main theme of our work behind for the time being, we shall concentrate on Uexküll's embryogenetic ideas as laid out in *Theoretische Biologie*. This aspect of Uexküll's theoretical biology appears, and in some ways is, scientifically outdated; nonetheless, it allows us not only to reconstruct the historical and theoretical context of his doctrine of the environment, but also to identify certain patterns of thought that run throughout all of his works – for example the concept of *rule* as an organizing unit of material. But let us proceed gradually.

Given its methodological and foundational intentions, Uexküll's *Theoretische Biologie* tackles the new scientific acquisitions of his time in a much deeper way than his other works did. This is particularly true for the theory of natural selection and contemporary evolutionist conceptions, because if on one hand Uexküll's clear refusal for the overall theory of evolutionism persists, on the other he does not go so far as to deny the importance of new discoveries in the field of genetics (first and foremost the discovery of genes and chromosomes). In this, Uexküll attempts – often with problematic results – to interpret the new elements in such a way as to render them compatible with his own teleological and neovitalist conception.

It is in this context that Uexküll elaborates a number of original ideas concerning embryogenetics. In this case, too, his departure point is the clear disciplinary separation between the study of the adult animal on one side, and the investigation into the origin of organisms on the other. If the former is oriented toward the discovery of the *functional rules* (*Funktionsregel*) in force in the adult organism which organize physiology and behavior, then the latter shall be directed toward the *ontogenetic rules* (*Entstehungsregel*) which guide formation. From a methodological perspective, it is appropriate to adopt two distinct approaches for the two areas of investigation. For the adult animal, it is useful to continue using the comparison to the machine – with the specification that, in the case of higher animals, the mechanistic model must admit not only excitability and movement, but also proper rules of environmental awareness (*Merkregel*). In embryology, instead, the analogy with the machine does not fit, and the researcher must proceed by hypothesizing the presence of super-sensible teleological factors capable of directly guiding the processes which occur in living matter.

The distinction between functional rules and ontogenetic rules must not be read as Uexküll supporting the opportunity to be mechanistic in the study of adult animals and vitalist in the study of the genesis of organisms. In Uexküll, a rule is always an immaterial factor, whether it be active in physiology and the perception of the adult animal or in the formation of individuals and species. The difference between the two areas of inquiry, rather, lies in the fact that in the adult animal rules have been translated into a fixed structure and have therefore become accessible to a mechanistic approach (as it is prevalently based on antecedent causality); while in the second, rules intervene directly, and so the organizing intervention of final causes needs to be postulated.[23]

As we have seen, Uexküll holds that within the natural world there are certain cases in which the immaterial factor acts directly even on the life of the adult animal, and these cases are thus incomprehensible using the analogy of the machine: for example the formation of the pseudopods of amoeba and the regeneration phenomenon of organs and tissue. In these cases, Uexküll writes,

> There exists a non-material order, which alone can give matter its structure – a rule of life. This rule is visible only in the fact that it molds the structure, which is achieved in a highly individual manner, in accordance with the material properties [of the beings in question] (von Uexküll 1928: 98).

The rule, therefore, is the *principle of the synthesis* of matter. And here again we have the clearly recognizable influence of Kant, in whose works the term "rule" often serves to indicate the ordering principle of a rational process (Kant 1999: 307–311, 242–243; Kant 2000: 31, 98); and this is entirely consistent with the author's explicit intent to extend the Kantian approach to biological inquiry. In regenerative processes, in the physiology of the amoeba and (as we shall see) in embryology, the rule assumes a value which is not only transcendental (as in the subjective constitution of the environment) but openly *constitutive*: the rule, which in itself is immaterial, acts on matter and gives it form. And, as we have seen for "impulses", its modality of intervention is twofold: on one part it guides the formation of fixed structures, and on the other it can intervene directly (in an occasional manner, as in the regeneration of tissue, or in a systematic manner, as in the amoeba).

In Uexküll's conception of the organism, the rule is the last level that empirical inquiry can reach: despite being incorporeal, atemporal and immaterial (and so unobservable in itself), the rule is accessible through the effects it exercises on matter. From a philosophical perspective, however, another force could be hypothesized, which Uexküll defines as "vital energy" [*Lebensenergie*], "natural factor" [*Naturfaktor*], or "natural force" [*Naturkraft*]" (von Uexküll 1928: 98). This force, of which Uexküll underlines its unknowability and the assertion of which has

[23]The problematic character of Uexküll's and other vitalists' conception will be taken up and clearly understood by Konrad Lorenz, according to whom the scientific productivity of some of their hypotheses (for example Uexküll's concepts of schema and the functional circle) and the validity of some of their discoveries depend on the fact that, in the concrete praxis of empirical research, they, too were mechanists (see Lorenz 1996: 231).

the status of a postulate, is ultimately responsible for the harmony and accordance in effect on every level of nature (in the single organism, among different organisms, in ecosystems, etc.)

After having specified what Uexküll means by rule, let us return to the particular case of *ontogenetic rules*, or rather the rules which preside over embryogenesis. Uexküll's proposal for an embryogenesis directed by rules (which are expressions of teleological factors, as explained above) fits into the contemporary debate among mechanists – whose stance often overlaps with evolutionists – and neovitalists. Uexküll, who disapproves of the evolutionist approach's excessive rigidity and blindness toward the purposiveness of organic processes, allies himself decisively with the neovitalists (first and foremost with Driesch).

In regards to the evolutionism of his time, Uexküll primarily refuses the conception – known as *preformism* – for which in the vegetable seed or the animal embryo there is a physically present structure which, in growing and developing, will later lead to the adult organism. The core idea of preformism is the isomorphism between the microscopic structure contained in the fertilized cells and the structure of the adult organism. Proposed in the seventeenth century by Malpighi,[24] then supported between the eighteenth and nineteenth century by scientists such as Leeuwenhoek,[25] Bonnet,[26] Haller,[27] Spallanzani[28] and Wolff[29] – all providing different versions according to the element which was seen as the bearers of the preformed structure (egg or spermatozoon) – this age-old conception intersects with the experiments on the formation of crystals carried out by the anatomist Prochàska.[30]

[24]Marcello Malpighi (1628–1694). Italian physician, microbiologist and anatomist, he dedicated himself to the study of embryology in the 1670s. His fundamental conviction, which would become the core of later preformist theory, is that embryogenesis consists in the primarily quantitative development of components which are already present (Malpighi 1673).

[25]Antoni van Leeuwenhoek (1632–1723). Dutch microbiologist and naturalist, he is among the first to intuit and take advantage of the potential of optical enlargement of studied objects in biology. The use of the microscope allowed him to identify the spermatazoon of many animal species; for him the discovery of spermatazoon indicated proof of the inconsistency of the Aristotelian theory of spontaneous generation. In his version of preformism, the developing structural elements that will lead to the animal adult are brought by spermatazoon and not by the ovule.

[26]Charles Bonnet (1720–1793). Swiss biologist, entomologist, and science historian, he worked with the phenomenon of parthenogenesis in aphids and annelids. His study in this field brought him to see parthenogenesis as proof of the preformist theory (he attributed this to the presence of ovules in organisms that regenerate).

[27]Cf. *above*, 53, n. 16.

[28]Cf. *above*, 50, n. 3.

[29]Cf. *above*, 54, n. 17.

[30]Jiří Procháska (1749–1820). Czech anatomist, he interpreted the formation of tissue and organs at the embryonal level as a process analogous to crystallization, a sort of "molecular attraction" (Cf. Dröscher 2008: 210) which, in repeating itself on always greater scales, eventually produces the complete organ.

The preformist ideas are countered by those of the epigeneticists, according to whom the development of the embryo is a continuous process based on the progressive adding of parts until the adult organism is fully formed. The term epigenesis, which was coined by William Harvey (1578–1657) in the seventeenth century, refers to various scientific stances which intended to eliminate or at least reduce the explicative recourse to extra-material forces. The epigenetic theories differ from preformism in two main positions: first they do not consider the fertilized cell as an isomorphic version of the adult organism, even on a reduced scale; rather, they see it as a distinct entity, homogeneous in quality but able to modify itself over time. Second, they find it unnecessary to suppose that within embryonal cells all parts and characteristics of the adult organism are present; instead, these parts and characteristics can be added and they gradually differentiate under the influence of ordering factors identified on a case-by-case basis.

Now, despite being unable to establish a clear correspondence between preformism and mechanism (or between epigenesis and vitalism), we can however affirm that the preformist theories are prevalently mechanistic. In the works of Haller and Bonnet, for example, the idea of the gradual formation and organization of tissue beginning from the fertilized cell was refuted, and embryogenesis is depicted as a mere quantitative growth of microstructures coming from the parent organisms (mostly from the mother). Moreover, during the period of Uexküll's work, the preformist theories were often linked to Darwinian evolutionism, in which the notion of the heredity of physiological and anatomical traits is central; and considering that in those years Darwinism was often given a very strict, deterministic reading, it is no surprise that this reinforced the mechanistic character of preformism.[31]

Uexküll grasped this problem quite well:

> Evolutionists have always tried to stay true to the dogma of an invisible structure present from the beginning in the embryo, assuming the existence of hereditary particles that would be somehow spatially linked to one another (von Uexküll 1928: 147).

Before the discovery that DNA acted as a set of instructions (and not at all as an organ in its growing phase), the theories based on the intuition of "hereditary particles" suffered from an ingenuity that made them particularly vulnerable to the attacks of proponents of vitalist theories.

To carry out his confutation, Uexküll divides the preformist theories into two groups: the so-called "mosaic" theories and the theories based on chemical hypotheses. Starting from the consideration of the organism as a mosaic of cells, the first group of theories hypothesizes that within the embryo (or better within the zygote) there is a "secret structure [*Geheimgefüge*]" (von Uexküll 1928: 155), "a micromosaic that is perhaps simpler than a macromosaic, but whose main

[31] As the initial structure of embryonal cells is seen as containing – in a fundamentally unexplainable way – all the traits of the adult organism, preformism acknowledges the action of extramaterial organizing forces on the material; this is the reason why in his *Critique of the Power of Judgment* Kant assigns greater credit to epigenetic theories than to preformism (Kant 2000: 291–292)

features already need to contain the features of the final mosaic" (which will develop from the former) (von Uexküll 1928: 155). The most noteworthy among the mosaic theories comes from Roux. According to him, the hereditary factors which determine the development of tissues are distributed unequally in fertilized cells. With the division of these cells, the child cells (called blastomeres) will be different from one another, and the embryo will initiate a self-differentiating development. In 1888, Roux tried to confirm this theory through experimentation and operated on a fertilized cell of a frog which had just undergone the first subdivision; Roux eliminated one of the blastomeres, and observed that the remaining ones continued to develop, but eventually gave life only to half an embryo (Roux 1888: 113–153).

The second group of preformist theories, which also has a mechanistic foundation, is based instead on the central function of hormones in the activation and carrying out of physiological processes. It hypothesizes that both the formation and the differentiation of the embryo are triggered and directed by "ferments" present in the germinal cells (von Uexküll 1928: 157–158). Uexküll states, however, that this process could be achieved only if all chemical influences were coordinated at a central level, and this (again) is only possible if we hypothesize a secret chemical structure in the embryo capable of guiding its development in an organized manner. Thanks to this observation, the theories of the second group are at least partially lead back to the first.

In Uexküll's eyes, therefore, the different evolutionist explanations for ontogenesis depend on one fundamental hypothesis, that of a "secret structure" which is spatially and materially present in the embryo. According to him, however, this hypothesis is definitely refuted in Driesch's experiments. In 1891, Driesch demonstrated that, by cutting the fertilized egg of a sea urchin in half, the development process of the embryo is not disrupted, but continues in both parts. Thanks to the action of entelechy, Driesch states, the embryo is configured as a "harmonious equipotential system", a vital whole in which (for a given phase of development) all parts have equal potential to develop; the physical separation of the parts does not, therefore, jeopardize the capacities of auto-organization of living matter. Driesch views his results as a direct rebuttal of Roux's theory, who supported the mosaic theory, for which the internal differentiation of the embryo depends on the initial cellular subdivision (cf. Driesch 1899: 39–41).

In line with Driesch, therefore, Uexküll argues that

> if there were an invisible structure in the embryo, it should to be divided too, when the embryo is divided. Instead, a halved embryo, as it develops, does not give two half animals, it gives two whole animals of half the size (von Uexküll 1928: 147).

The conclusion that Uexküll draws from Driesch's experiments supports the neovitalist hypothesis of the active presence of a rule of formation: "Whereas an anatomical structure, being spatially expandible, can be destroyed by surgery, a rule, which is in essence immaterial, cannot be damaged by a blade". To respond to the fundamental question that arises from his position ("how does the rule act on the protoplasm of the embryo?") (von Uexküll 1928: 148), Uexküll refers to the theory of impulses, which was already used to explain the formation of the pseudopods in

amoeba. From a philosophical point of view, we should remember that, according to Uexküll, the action of the will, understood as a teleological factor, is behind the sending of impulses.

But *Theoretische Biologie* does not intend only to refute preformist theories. As we mentioned above, its intention is to reconcile the vitalist hypothesis of the rule of formation with the recent discoveries in the field of genetics and embryology, discoveries whose importance could not be denied and were not directly invalidated by critiques to mechanism. The two main points where this strategy of integration takes shape are represented by the anti-Darwinian reading of Mendel's discoveries and by the attempt to see genes and chromosomes as transmission rings for the rule's influence.

As far as Mendel is concerned, Uexküll had already given a positive evaluation of his work in the article *Mendelismus* in 1910 (von Uexküll 1910). Here Mendel's laws are examined as an evidence supporting the immateriality of the factors which govern heredity. Uexküll's argument is the following: if material structures (physical or chemical) were present in the embryo, whose evolution would bring about the adult animal, and if those structures came partly from the mother and partly from the father, the result should always be a mixture of the properties of both parents. Mendel, instead, clearly demonstrated how heredity acts on pairs of characters (one dominant, one recessive) which do not mix with one another, but emerge in the generations of descendants according to fixed and unmodifiable proportions.

Now, according to Uexküll everything that is material is subject to changes by degree, so this capacity of living things to operate following "fixed quantities" (von Uexküll 1910: 1592)[32] is imaginable only as a consequence of an immaterial factor. And for Uexküll this is the reason for which materialists and Darwinists "did not applaude" Mendel's discoveries, even if they showed "that another sector of living nature abided by a mathematical rule" (von Uexküll 1910: 1592)

In *Mendelismus* the immaterial factors responsible for the application of Mendel's laws in the development of the adult phenotype are called *modelers* (*Bildner*). Uexküll mentions only that these are immune to previous causal influences and that they exclusively abide by the overall finality of nature, of which they are the expression of a single "action" (von Uexküll 1910: 1593). Returning to one of his favorite comparisons, that of the construction of a building, Uexküll states:

> The previous [mechanicist and preformationist] theories hypothesized that in the embryo of a house there was already *en miniature* a brick, a tile, a step, etc. – from which, by growth and division, the house originated. Mendel provides a better theory: in the embryo of a house are set in a definitive way the height of the wall, the shape of the window, the slope of the roof, the width of the stairs, etc. (von Uexküll 1910: 1593).

[32]Until the revision process of Darwinism promoted primarily by Gould, however, gradual change was the type of change most widely privileged by Darwinists. *Cf.* for example Gould 2002: 1651.

This hypothesis, Uexküll continues, is only plausible if we consider the specific material onto which modelers act, i.e. that incredible amalgam of forces and substances that is protoplasm – from which, Uexküll writes, "practically everything can be derived" (von Uexküll 1910: 1594).

In *Theoretische Biologie* the anti-Darwinian reading of Mendel's contribution is even more resolute. First, Mendel's intuition that the properties of phenotypes behave as non-modifiable quantities or units is evidence to Uexküll of the constancy of nature, and so is a direct rebuttal of the Darwinian theory of the variation of species (von Uexküll 1928: 163).[33] Secondly, the notion of the rule elaborated in this text means Uexküll can confirm that Mendel's identification of the rules of heredity coincide with the discovery of the immaterial factor which governs the formation of the embryo. In other words, Uexküll does not believe it necessary to postulate a factor that is different from the rules and appointed to its application (the *Bildner* of *Mendelismus*): now the rules themselves, and the impulses which move them, *are* the immaterial teleological factor which governs vital processes. Mendel deserves credit for having brought them to the attention of the scientific community.

However, the resolute assertion of the immateriality and non-spatiality of modeling factors (impulses and rules) does not exonerate Uexküll from his duty of identifying the material place in which, within the embryonic cells, the rules are translated into structure. And this is the need that Uexküll addresses in the second point of his strategy to integrate the scientific discoveries into his neovitalist conceptions: this place, in fact, is found in genes and chromosomes. In direct connection to the works of Johannsen[34] and Morgan,[35] Uexküll sees the chromosomes as the bearers of somatic characteristics (recessive or dominant) and the genes as "material substrate" – and, as far as the latter are concerned, "their relationship with the impulses makes autonomous factors out of them" (von Uexküll 1928: 160; see also 167). Uexküll's strategy is clear. In the impossibility to ignore new scientific data such as genes and chromosomes, he reserves a subordinate role for them. Chromosomes become the seat of expression for rules of construction, which are expressed in mitosis and in differentiation in tissues, but the rules maintain their status of immaterial teleological factors.

[33] In support of the constancy of the characteristics of organisms Uexküll also mentions Jenning's experiments on parameciums, which (according to Uexküll) demonstrate the invariance of phenotypes after thousands of generations (provided that reproduction of these organisms does not occur sexually).

[34] Wilhelm Ludwig Johannsen (1857–1927). Danish biologist, one of the founders of genetics; the first to give the name of "gene" to the basic unit assigned to the transmission of the information that determines hereditary traits and to provide a precise conceptual distinction between genotype and phenotype (Johannsen 1909).

[35] Thomas Hunt Morgan (1866–1945). American embryologist and geneticist, one of the founders of genetics; his studies on *Drosophila melanogaster* led him to understand the genetic base of the Mendelian transmission of dominant and recessive characteristics and to identify the chromosomes in which genetic information is found (Morgan 1913).

Uexküll's ideas are obviously unable to satisfy the explicative needs of modern science. The recourse to an immaterial factor (rule), which is not submitted to the laws of antecedent causality and active only in a teleological sense, is not only irreconcilable with the scientific image of the world but also presents the problem of the inexplicability of the relationship between immaterial and material factors. Uexküll accepts this inaccessibility of ultimate causes as an irremovable boundary of the cognitive relationship between man and nature, while modern science is unwilling to recognize any programmatic limits of this kind.

Nonetheless, in relation to the materialist theories of his times, Uexküll's interpretation of the role of chromosomes contains a truly modern aspect. In his paragraph dedicated to the ontogenesis of living beings, Uexküll writes:

> If we compare the hereditary factors present in chromosomes with the keys of a piano, which – every time they are pressed – send out in the cell's plasma a ferment that modifies its metabolism, and if we assume that cellular substances are synthesized at every change, we will get a rough idea of the protoplasmatic cells and the cells of the tissues (von Uexküll 1928: 168–169).

If considered alongside the analogy of the house in the previous quote – in which Uexküll sees the embryo as the depository of building instructions – the comparison between the directive activity of hereditary factors present in chromosomes and the functioning of the keys of a piano is quite revealing. The metaphor, in other words, reveals that Uexküll holds close to the idea that hereditary factors are a *code to be interpreted*; but for him that code must be immaterial, and matter must appear only as material support of the decoded text. The concrete expression of the ontogenetic rules of embryogenesis is thus made to resemble the process of writing, in which an idea is translated into matter using the material supports of pen and paper. As seen previously, the influence of Kant is evident here, but even more evident is that of Plato.

In terms of a correct understanding of the functioning of genes and chromosomes, however, Uexküll's platonic layout has substantial limits. The discovery of DNA presented modern biology with a phenomenon that is clearly alien to platonic categories: the existence of a code that is not only deposited within matter, but in order to be used does not require any link with the ideal sphere (both understood in an ontological sense, as in Plato, or in a more modern psychological, representative or cognitive sense). The reproduction of organic matter thus takes the shape of a *material* semiotic process. It is semiotic because it includes all the components of communication based on signs (signifier, signified, and subject, as was suggested by de Saussure's analysis of linguistic signs; cf. de Saussure 2011: 67); and it is a material process, because the signifiers (the combinations of nucleic acids which make up a DNA strand), the signified (the amino acids which are synthesized on the basis of those same strands), as well as the decoding element (the cell which synthesizes new tissue) are all material.[36]

[36]The semiotic reading of the decoding of DNA can also avail itself of other concepts taken from modern linguistics, such as the distinction between code and message (cf. for example Jakobson

Setting aside the theological and religious motivations, a large part of the refusal (or just wariness) which received the modern synthesis of genetics and Darwinism is due to the following conception: the idea that *the genome is a set of instructions that do not need a mind that first conceives of them in abstract and then imprints them in matter*. Uexküll's conception of rule as an immaterial modeling factor, instead, fits entirely into the platonic tradition. To give another example, in speaking of the rules which constitute biological systems more complex than a single organism, like species, Uexküll states: "In them, a rule "became flesh". This "becoming flesh" occurs everywhere through the impulses that have to abide by the rules" (von Uexküll 1928: 189).

Therefore, the gap between Uexküll's conception and the knowledge of our time about the functioning of DNA is vast: on one side the postulate of the existence of immaterial factors and the adherence to the teleological model, on the other the exclusive recourse to antecedent causes and the discovery of an autonomous decoding capacity on part of living matter. The search for possible converging points between these two visions must then leave out of both the nature of the informative code and the type of causality called into play, and focus instead on the common idea that the formation of living beings – and thus the environments of animals and their ecosystems – is a semiotic process. Even if this idea is founded on incorrect scientific suppositions, the extraordinarily modern character of this intuition makes Uexküll one of the undisputed precursors of the recent field of biosemiotics (cf. *below*, 225).

5.3.4 The Origin of Species in Theoretische Biologie

Although he appears open to the theory of Mendel and is relatively willing to accept the scientific discoveries of Johannsen and Morgan, Uexküll does not retreat from his staunch opposition to Darwinian ideas. His refusal of the theory of evolution through natural selection is often expressed in rather harsh tones:

> If someone wanted to claim today that, ages ago, a fish thrown onto Earth would get rid of its gills under the influence of the new environment in order to grow lungs; he would get the answer: "Don't speak nonsense, if a fish finds itself out of the water, it dies" (von Uexküll 1928: 168–175).

Yet, besides the sarcasm, what is most striking about Uexküll's stance is the fear that the living organism loses its organizing autonomy in favor of the direct action of

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1971: 559–561). In human communication we can distinguish between code (for example Morse Code) and message (an SOS), and the same can be done in genetics: the genetic code (the system of correspondences among groups of nucleic acids and proteins, which is the same for all living organisms on earth) is distinct from single messages (the genomes of various species). And fundamental observations about the distinction between processes of code semiosis (among which the DNA decoding) and processes of hermeneutic semiosis have been recently developed by Marcello Barbieri (cf. Barbieri 2003, 2008, 2012).

the environment. This fear is common of many anti-Darwin scientists and philosophers, who since the appearance of *On the Origin of Species* have tended to see the ideas of natural selection as a sort of philosophy of environmental determinism. More than of a direct reading of the works of Darwin, this interpretation is often the fruit of the mediation of Spencer, whose statement that life is adaptation of internal processes to external circumstances often seemed to sum up the new conception of organisms. In fact, Spencer was not a pure Darwinist at all, as we find a strong Lamarckian influence in his vision of evolution; in admitting the possibility of the emergence of heritable variations in response to environmental challenges, Spencer reintroduces final causality into the process of the differentiation of species (which is at the base of the idea that a future state of improved adaptation could be the real cause of a small, current variation).

In spite of this distinctive trait (which was often ignored then and continues to be overlooked today), Darwin and Spencer were grouped together as theorists of environmental determinism; an excellent example of this is found in Nietzsche, who in his *Genealogy of Morals* states:

> [From] physiology and the understanding of life [is today disappearing a] fundamental concept, that of real *activity*. By contrast, under the pressure of this idiosyncrasy we push "adaptation" into the foreground, that is, a second-order activity, a mere reactivity; in fact, people have defined life itself as an always purposeful inner adaptation to external circumstances (Herbert Spencer). But that simply misjudges the essence of life, its will to power. That overlooks the first priority of the spontaneous, aggressive, over-reaching, re-interpreting, re-directing, and shaping powers, after whose effects the "adaptation" then follows. Thus, the governing role of the highest functions in an organism itself, the ones in which the will for living appear active and creative, are denied (Nietzsche 1997: 59).[37]

Returning to Uexküll, his reading of Darwinism is even more deterministic. According to him, the factors that determine the development of organisms and species in Darwin's theory cannot be generically environmental but can be reduced to physical-chemical dynamics:

> According to Darwin the hypothesis of actions [*Handlungen*] on nature's part is absolutely false, there are actually only mechanical and physical processes. As long as the processes of the living nature were heard without prejudice, it was impossible not to hear the peculiar rhythm characterizing all that lives and forms its intrinsic norms. All this ended afterwards and there was no more autonomy of life (von Uexküll 1928: 245).

If this is true, it is important to note that, in the context of *Theoretische Biologie*, a work which has often proved open to contemporary biology, Uexküll

[37]Reflecting on this quote in *Versuche zu einer Philosophie des Lebens* [*Attempts at a Philosophy of Life*], Max Scheler sees in Nietzsche a sharp critic of evolutionism, and for a very clear reason: "[[Nietzsche] saw that Darwin and Spencer had "removed" the concept of "activity" from the concept of life; Spencer defined life as the "adaptation of inner processes to outer circumstances", which Nietzsche found unacceptable. [. . .]. [In the] conception underlying organic nature, which was Darwin's starting point, all the growing and developing processes do not have the positive strength of primal causes as far as individual "evolution" is concerned, but they are exclusively epiphenomena of the protective processes related to what is casually useful, and are then followed by the negative activity of removal of the inadapted" (Scheler 1913: 315, 317).

cannot refuse new ideas *in toto*. He does not completely ignore the hypothesis that biological species have had an origin which is differentiated in time – speaking of the distinction between races and species, for example, he states:"[In races] we can see the very beginning of the formation of new species" (von Uexküll 1928: 184) – but he refuses the Darwinian interpretation of this phenomenon. Specifically, when faced with new anatomical and physiological knowledge – which underline the phylogenetic continuity among fish, reptiles, birds, and mammals, and showed how new acquisitions were inserted onto previous structures – Uexküll admits that there can be organizational leaps which bring about new species, but he attributes them to the sudden intervention of teleological factors. His refusal of the idea of evolution thus dissolves into the wish that the Darwinian theory of the gradual adaptation of species in the environment could be replaced by the "doctrine of rapid adaptive insertion [*Einpassung*]" of new species in their environment (von Uexküll 1928: 176); as in the case of the relationship between the single animal and its environment, the term *Einpassung* (adaptive insertion) is suggested as an anti-Darwinian alternative to that of *Anpassung* (adaptation).

In other words, for Uexküll the formation of new species would not come from the development of single characteristics – deriving, according to the "new synthesis" of Darwinism and genetic science, from casual mutations of the genome – but rather from a complete upheaval in the building-plan. Considering then the very close connection that links the building-plan and the active functional circles of every species, it is no surprise that Uexküll states:

> In order to be able to speak of authentic diversity, a new functional circle must emerge in the buidling-plan. A progressive passage [. . .] is fundamentally impossible, because, when a new functional circle appears, it always means the reconversion of the entire organism. [. . .] Every newly established functional circle founds a new animal species, [which] thanks to its double relationship with the environment, is sure to be able to adaptively integrate itself [*sich einpassen*] into the new environment (von Uexküll 1928: 198).

Although marked by the basic error of the faith in the action of natural immaterial factors, which are empirically impossible to investigate, nonetheless the Uexküllian conception of the origin of species casts light on a central aspect of the evolution of species: a new species is also a new modality of relating with the environment. In Uexküllian terms, every new species casts light on aspects of the environment – a coherent whole of *Merkmale* and *Wirkmale* – which until that moment had remained hidden. From Uexküll's point of view, the study of a new species is also the in-depth study of the *sense-endowment* of its environment, the addition of a new piece in understanding the overall puzzle of its ecology. It is here that Uexküll can make a valid contribution to contemporary biology, even if today such an inquiry into the ecology of species cannot be carried out within a vitalist and teleological conception of organisms.[38]

[38]Regarding the idea that the environment is a biological phenomenon endowed with sense see the section in Chap. 7 dedicated to Merleau-Ponty (cf. *below*, 276) and Brentari 2010.

Returning to Uexküll's opposition to the theory of evolution by natural selection, it is worth underlining that, according to him, the term evolution can be used only in the meaning of the *purposeful change* of biological structures:

> [According to Darwinists], variation is a chemical process which, in an utterly unplanned way, produces living beings among which the struggle for survival mechanically culls out [*ausmerzt*] the unadapted, i.e. those unfit to live.[. . .] The structure of the current animal kingdom would therefore be the product, without any reference to a plan, of physical factors on an chemism. It beats me how we can define this conception as an evolutionary one. At any time, the exterior [environmental] factors can lead to the suppression of complex animals and make simpler animals the only ones able to survive, thus going back to original animals (von Uexküll 1928: 195).[39]

Uexküll's position proves to be affected by one of the most common misunderstandings of the Darwinian theory of evolution: the idea that the different factors involved in evolution – genotypical mutations, phenotype variations and selective action by the environment, other species and conspecifics – must *spontaneously* and *necessarily* combine in order to bring about a state of improved perfection of species. In this perspective, evolution maintains its traditional (or Aristotelian) meaning of a change towards a state of improved completeness. The innovative charge and the scientific value of the Darwinian concept of evolution fully emerge only if it is understood as a principally neutral modification of inherited biological structures, which reveals itself as positive or negative only according to the conditions (intra- and extra-organic) given on a case-by-case basis.

What Uexküll is unable to accept, in short, is the idea of the radical contingency of the evolutionary process. This refusal appears in numerous ways, the following being one of the most significant examples: Uexküll believes a situation in which "lower" organisms prove to have better environmental adaptability than higher ones is biologically contradictory, while it is entirely possible in the Darwinian theoretical context. This situation occurred and continues to occur every time that, in the presence of a close link between a species and its environment (i.e. of an elevated degree of specialization of the species), a sudden environmental change puts the survival of a certain species at risk and allows instead for the survival of species that are less constrained by specific environmental traits. It is no coincidence, then, that Uexküll does not have the theoretical tools available to deal with those themes which are closely linked to the idea of the contingency of evolution – such as the problem of the extinction of species, which in his works is never dealt with in a systematic manner, or that of the existence of rudimentary organs and behavioral strategies which are not completely adaptive (von Uexküll 1928: 137; see also *below*, 147, 223).

[39] It is interesting to note how the continuation of this quote brings the Lamarckian position back among authentic evolutionary theories: "Unlike Darwinists, Lamarckians acknowledge the action of a molding force, which produces planned structures in a planned way. This is why they can speak [for themselves] of an evolutionary theory" (von Uexküll 1928: 195).

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Chapter 6
Environment and Meaning

Abstract The chapter deals with two of the best known works of Uexküll, *A Foray into the Worlds of Animals and Humans* and *A Theory of Meaning*, and focuses on the behavior of higher animals (that includes issues such as territoriality, individual recognition, imprinting, etcetera). According to the Estonian biologist, these phenomena are due to the emergence of superior environmental traits, such as the *function* and the *meaning* of particular images, individuals or places. This approach is linked to the idea of the *semiotic variability* of the Umwelt, in particular in higher animals and human beings. The chapter ends with a synthetic exposition of some of the philosophic dialogues Uexküll dedicated to problems such as the overall teleology of nature, the question of immortality, the role of the individual in a biological species.

Keywords Semiotic variability of the Umwelt • Territoriality • Individual recognition • Operative images • Ethology • Individual/species • Personal immortality

6.1 Between Theoretical Biology and Ethology: *A Foray into the Worlds of Animals and Humans*

Uexküll's book which has enjoyed the most widespread circulation is *A Foray into the Worlds of Animals and Humans*,[1] a short and easy book whose intention is to make Uexküll's thought known to a wider public than that of his previous monographs and articles in scientific journals. The target is a public of cultured but not specialized readers, who are attracted by the problems of animal behavior but much less interested in questions of theoretical biology – these were basically the same readers who in a few years would follow the studies of young Lorenz and then the affirmations of animal ethology in European scientific culture.[2] In *A Foray into the Worlds of Animals and Humans*, the study of animal behavior is presented

[1] See *above*, 30, n. 67.

[2] In the first half of the 30s during a series of popular conferences promoted by the Austrian cultural association Urania, Lorenz also realized that there was a growing interest in a larger public (Föger and Taschwer 2001: 57–58).

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as a fascinating undertaking; translated literally, the title of the German edition reads, in translation, *Forays in the Umwelten of Animals and Humans: A Picture Book of Invisible Worlds*, which clearly shows Uexküll's educational intentions (von Uexküll and Kriszat 1956).

The core of the work is made up of a series of interesting cases of environmental studies drawn from the lives of animals as well as numerous digressions into the fields of folklore and popular psychology. Although it is re-elaborated, a large portion of the material comes from previous works; besides Lorenz's experiments with social corvids and von Frisch's with bees, to which Uexküll dedicates ample space, and along with some clarifications of minor importance (on the perception of shapes by the earthworm for example), no novelties in experimentation are set forth. The aim, rather, is to convey a very simple message: the environment of every animal species is a specific and original perceptive and cognitive construction, which is empirically accessible starting from the observation of the exterior behavior of single subjects.

As mentioned above, Uexküll's references to the experiments conducted by Lorenz in the 30s play an important role in *A Foray into the Worlds of Animals and Humans*. We will return to their relationship in Chap. 7, but it is important to emphasize how in this period the two scientists' plan of carrying out a common project seemed entirely feasible. Lorenz hoped to collaborate with Uexküll at the *Institut für Umweltforschung* in Hamburg, which he visited in 1936. In terms of theoretical products, two works bear witness to the closeness of Lorenz and Uexküll: *Companions as Factor in the Bird's Environment* (Lorenz 1935)[3] and *A Foray into the Worlds of Animals and Humans*, in which Uexküll utilizes a large amount of material sent to him by Lorenz (among which there are some illustrations Lorenz drew himself to exemplify certain behavioral modules of jackdaws and starlings[4]). In *Companions as Factor in the Bird's Environment*, in which the hierarchical structure and the social behavior of animals are described, Lorenz effectively demonstrates notable consonance with Uexküll's approach: the conspecifics are seen as an integral part of the *Umwelt* of the single animal as well as components of well-determined functional circles. The life cycle of social birds assumes the form of a series of functional circles (and of environments) that are largely independent from one another and centered time by time on relations with parents, children, the sexual partner, etc.

It is thanks to this pre-existing consonance that in *A Foray into the Worlds of Animals and Humans* Uexküll can directly use the empirical evidence which

[3] *Companions as Factor in the Bird's Environment* (original title *Der Kumpan in der Umwelt der Vögel*) was published in the "Journal für Ornithologie" in 1935; but the previous year Uexküll had been given the work as a gift on occasion of the *Festschrift* for his 70th birthday, and he had already received some material from Lorenz in 1933 about his results on social corvids.

[4] The material sent to Uexküll comes mostly from Lorenz's research from the end of the 20s and the beginning of the 30s, that can be found in K. Lorenz, *Contributions to the Study of the Ethology of social Corvidae* (Lorenz 1931) and *A Consideration of Methods of Identification of Species-specific Instinctive Behaviour Patterns in Birds* (Lorenz 1932).

Lorenz provided him with, integrating it into the general structure of the work. For Uexküll, the presence of individually recognized conspecifics and the possibility of certain social animals to instill very precise relations of attachment at an early age in terms of the determination of the object (the dynamic that will come to be called imprinting) are clear signs of a further enrichment of the environment of higher animals. In other words, after the perception of objects that are increasingly differentiated among one another, social species reach a further level of organization of the environment: the presence of a set of perceptive marks and operative marks that constitute the conspecifics in general or even a particular conspecific.

The faith that Uexküll has that the rising ethology can directly confirm his own theoretical approach, however, does not take into account a profound difference. For Uexküll the cognitive and operative agreement between the animal subject and its environment, just like among different animal subjects, is the outcome of the overall teleology of nature – which is due to factors that are ultimately impossible to investigate. For Lorenz – due to Darwin's influence – the agreement between subject and environment is, rather, the result of an adaptive process which does not call into play any superior teleological factors in the individual organism and in the given environmental conditions (see *below*, 224). Still, in the two texts mentioned above, this divergence is not explicitly conveyed; perhaps due to the fear of a potential split, neither Lorenz nor Uexküll linger on the origin of perceptive and behavioral agreement between organism and environment. In this phase their common intention is, rather, to describe certain cases of particularly clear harmonious interaction between the two poles and to underline the active role played by the subject in the instituting of relations with the external world.

Continuing with the areas the two researchers have in common, it is important to note that in both of them the exposition of their own theory is accompanied by a sharp critique of American behaviorism. Uexküll's contrast with behaviorists takes up the cues and argumentations which he had already made against mechanism in previous works; what is more, the "Premise" of *A Foray into the Worlds of Animals and Humans* conveys the idea that behaviorists are the mechanists of the twentieth century, and that a true understanding of the animal and human environment must overcome the idea that behavior is nothing more than a series of reactions by effector organs to the impact of external stimuli. Moreover, Uexküll opposes the excessive importance which behaviorists assign to the brain, an organ which (furthermore) is mistakenly thought of by them as a center for the automatic sorting of impulses and reactions.

But the point where the limits of behaviorism seem particularly serious to Uexküll is in its concept of man. Again, this critique follows his earlier criticisms of mechanism:

> By means of the impossible construction of a combined operative-perceptive tool [*ein kombiniertes Merk-Werkzeug*], it is not only in the case of animals that one has stitched together the sensory and motor organs like machine parts (without taking into account their perceptive and effective functions). One has also gone so far as to mechanize human beings. According to the behaviorists, our sensibility and our will are mere appearance. In the best case, they are to be valued only as background noise (von Uexküll 2010b: 42).

In *A Foray into the Worlds of Animals and Humans*, therefore, opposition to behaviorism embarks on a particular path, which helps explain the success of the book. First of all, the author takes great care not to reignite the age-old theoretical dispute between mechanists and vitalists, practically neglecting the question of the immaterial teleological factors which determine animal behavior. He limits himself instead to providing few fundamental theoretical indications before proceeding with the description of a vast range of animal behavior, much of which (as the author notes almost *en passant*) prove impossible to explain moving from behaviorist and, in general, mechanistic assumptions.

This choice is a part of a much larger strategy. Although it is consistent with the fundamental theories set forth in *Theoretische Biologie*, *A Foray into the Worlds of Animals and Humans* provides only a simplified exposition of them. Here Uexküll almost entirely abandons anti-Darwinian polemics and the search for agreement between recent genetic discoveries and his own vision of living things; rather, he only briefly rediscusses certain key elements: the theory of the functional circle based on perceptive and operative marks, the notions of spatial and temporal signs, the importance of the subject and its transcendental structures in constructing the environment, the concept of the species-specific environment as a union of the perceptive world (*Merkwelt*) and the operative world (*Wirkwelt*).

This applicatory use of these notions results in a deft presentation of certain animal environments chosen out of the ones which have assumed a paradigmatic value for Uexküll in his years of study: the paramecium, the tick, the jellyfish, the sea urchin, the dog, the jackdaw, etc. As regards lower animals, the choice of environments dealt with in *A Foray into the Worlds of Animals and Humans* does not significantly differ from his past works, whereas the analysis of higher environments shows some innovation: ample space is given to the phenomena of the integration of the basic perceptive environment with superior elements (such as operative images, which we will deal with in detail).

6.2 Lines of Action in the Subjective Environment: Operative Images

The fundamental idea of *A Foray into the Worlds of Animals and Humans*, which Uexküll attempts to convey with simple and accessible language, is that animals do not limit themselves to receiving an already formed external world but are constantly engaged in an active process of sense-conferring. Every species, we must remember, uniquely performs a work of synthetic unification and outward transposition of stimuli (von Uexküll 2010b: 50, 60), which in themselves (i.e., at an intra-organic level) are none other than waves of excitation without any relation of similarity with traits of the external reality. And the results of this process are extremely varied: they range from extremely poor environments such as that of the medusa – which is made up of a single stimulus that cannot even be transposed to the outside (von

Uexküll 2010b: 75) – to ever richer environments such as the dog's, which is so flexible in its constitution as to include perceptive marks that are useful to other species (in particular man; von Uexküll 2010b: 96).

The lay-out of the work is similar to *Umwelt und Innenwelt der Tiere*: Uexküll wishes to show that the richness of environments on the one side and the physiological and behavioral complexity of animals on the other are linked by a relationship of direct proportionality. In *A Foray into the Worlds of Animals and Humans*, however, (following *Theoretische Biologie*) the author reserves a much larger space to what he considers the basic coordinates in the constitution of environments: space and time. Thus, the idea that every species organizes its environment according to a different spatial and temporal "network" emerges once again; in other words, it is the diversity in the least perceived units of space and time (spatial and temporal signs) which determine a different rhythm of experience in every species. Those units can be investigated through experimentation. It is possible, for example, to measure the time intervals necessary for two perceptive stimuli to be distinguished from one another by a specific animal subject.[5]

Differently from *Umwelt und Innenwelt der Tiere*, however, the analysis in *A Foray into the Worlds of Animals and Humans* does not stop at the threshold of the domain of higher animals. This means that other coordinates are added to the environment's basic coordinates, in a progressive re-elaboration of perceptual, spatial and temporal data.

One of the most important of these "superior environmental features" is what Uexküll defines "coloring" (*Färbung*) or "tone" (*Ton*) of stimuli: wherever they come from, upon insertion into a certain functional circle, the stimuli are charged with a particular qualitative coloring which overlaps the content. Prey is not perceived as something neutral, but rather as an object "colored" by a particular feeding tone (*Freßton*). Further, a specific mood of the organism (*Stimmung*) corresponds to the coloring of the environment: to make another example, in the environment of a prey the predator assumes a particular coloring, called escape tone, which corresponds to an interior condition definable as a diffuse sense of fear or threat.

As Portmann states in the premise of the 1956 German edition of *A Foray into the Worlds of Animals and Humans*, the search for the precise correlation between object characteristics and interior experience is one of the most relevant traits of the Uexküllian approach:

> [Uexküll] notes that the things in the environment have an *experience tone* [*Erlebniston*], that their role is given to them according to a quality, which we indeed do not know

[5] Also in terms of the concrete structuring of these coordinates, there are interspecific differences which are motivated by the necessity to manage different amounts of stimuli. It is important to note how the most elementary level of spatial and temporal organization is (so to speak) an empty network: "Space and time" – writes Uexküll – "are of no immediate use to the subject. They only become meaningful when numerous perceptive marks (features) must be distinguished that would otherwise coincide without the spatial and temporal framework of the environment. However, such a framework is not needed in simple environments" (von Uexküll 2010b: 73).

> in its subjective content, but whose effect we can work out through the animal's action. The discovery of this "coloring" of objects gives way to a new line of research [...] which ultimately leads to recognizing the "mood" [*Stimmung*] as one of the last accessible biological realities (Portmann 1956: 10).

Just like spatial and temporal coordinates, experience tones and the corresponding moods vary a lot in the animal world. In the environment of the paramecium, one of the most limited environments, stimuli with a single tone are present, the escape tone. Here all the quanta of excitation transposed outward and then reperceived are colored by the uniform and threatening tone of an "obstacle to be avoided"; which is to say, of all of the "things" present in its environment the paramecium notices only one characteristic, the one which characterizes them as obstacles and which induces the animal to flee.

In the life cycle of this single-cell organism there is, therefore, a single functional circle with reperceived elements, which is the functional circle of escape. The other functional circles, such as feeding, are characterized by an absence of perceptive marks: the paramecium in constant flight from whatever it can perceive "can rest only once it arrives at its feed, the putrefactive bacteria, which, alone of all the things in its environment, send out no stimulus" (von Uexküll 2010b: 74). Using Uexküllian terminology, in the case of the paramecium we have an operative mark which is active in the functional circle of feeding without being accompanied by any perceptive mark or any particular tone of experience. It is quite an unusual case: usually, the encounter between the organism and its prey is marked by stimuli loaded with a specific and unmistakable feeding tone, which corresponds to the emotive condition of hunger (perhaps mixed with aggression).

Among Uexküll's various proposals, one of the clearest examples of the tonal variability of environments and moods is found in the hermit crab (*Pagurus bernhardus*) confronting a sea anemone (*Anemonia sulcata*). Here, the emotive tone acts as the determining factor, while the coloring of the perceived object acts as a dependent variable. If the hermit crab has been held without food for a long time, the anemone assumes a "feeding tone"; if it is deprived of the anemones which crabs usually have on their shell (and which defend them from the attacks of predators), the anemone assumes a "defensive tone"; if it has lost its shell as well as the mimetic anemones, the anemone assumes a "dwelling tone" (as proved by the hermit crab's vain attempts to enter inside it) (von Uexküll 2010b: 93).

The discovery of the object tone brings about two very significant observations. First and foremost, Uexküll states that the organism's varying emotive tones requires that the object itself is attributed a different biological meaning.[6] Secondly, the understanding of the object tone requires an integration of the theory of perception which Uexküll has hereto supported: on the phenomenological level, besides perceptive and operative marks, the presence of a third entity is necessary, the

[6]This highly important idea shall be explored in greater detail in the analysis of *A Theory of Meaning* (cf. *below*, 195).

operative image (*Wirkbild*). This overlaps the objects which have already been established in the perceptive environment and (just as objects are) is consciously reperceived: "already in the environment of the arthropods" – writes Uexküll – "the perceptive image provided by the sensory organs can be completed and altered by an "operative image", which is dependent on the next action that takes place" (von Uexküll 2010b: 93). A particularly clear example of operative tone can be found in the ethology of the dragonfly: "When a dragonfly flies toward a branch in order to alight upon it, the branch is not just present in the dragonfly's environment as a perceptive image but is also distinguished by a sitting tone" (von Uexküll 2010b: 96). The operative images, which in all probability form "in the central operative organs" (von Uexküll 2010b: 95) of animals (the brain and nervous system), "are [basically] acts of animals which are projected into environments" (von Uexküll 2010b: 95).

The reference to the biological significance of environmental objects and the overlapping of perceptive mark and operative image – which could be considered a sort of "reperceived operative mark" – are two fundamental steps in Uexküll's opposition to the behaviorist interpretation of animal action. Both elements – meaning and operative image – are opposed to the model centered on the elementary mechanism of reflex. Incidentally, this does not mean that Uexküll does not believe in the existence of behavioral reflexes, but rather that these are minor even among lower animals and certainly not paradigmatic: "All animals that operate in a purely reflective manner, such as the sea urchin, must be excluded from this category. But for the other cases, as the hermit crab proves, the influence of mood is felt far down in the animal kingdom" (von Uexküll 2010b: 95).

The behaviors in which operative images intervene became more important as Uexküll focused on higher animals. At this level, in fact, the operative image begins to transform without any solution of continuity into an even higher environmental trait, the *function* of objects. Like operative images, the "function-tone" of objects is also a result of the projection of a particular typology of behavior into the environment. In Uexküll's theory of action, this behavior was defined as plastic action (cf. *above*, 137).

Uexküll provides two emblematic cases of this behavior and its environmental correlates. The first is the case of the dog, which after having learned to respond to the command "chair" by climbing onto a chair, in the absence of available chairs looks around for objects which it can use to execute the command. In this "looking around", the operative image acts as a filter which, applied to the environment, highlights only the perceptive nuclei which respond to specific functional requests. So, Uexküll observes, "a whole series of other objects, such as boxes, shelves, and overturned footstools, acquired a "sitting tone" [*Sitzton*] as we would like to put it" (von Uexküll 2010b: 94). Yet training can lead the dog to also include perceptive signs in its environment which did not originally have any meaningful tone for them; it is the case of guide dogs, who must pay attention to elements which is important only for human beings (such as footpaths, or the height of a door) (von Uexküll 2010b: 96–97).

The second example of the connection between operative image and the function of environmental objects is drawn from the behavior of human beings. In this area the problem can be stated thusly:

> How we do notice the sitting of the chair, the drinking of the cup, the climbing of the ladder, which is not given to the senses in any case? We notice in all objects that we have learned to use the act which we perform with them, with the same assurance with which we notice their shape or color (von Uexküll 2010b: 94).

As with the dog, the understanding of the function of a new object for humans (or a new function of known object) depends mainly on a process of learning. To illustrate this Uexküll recalls an episode which occurred during a scientific expedition in Dar es Salaam (Tanzania) which had already been recounted in *Theoretische Biologie*: Uexküll asked an intelligent, young, able African man to climb a ladder. The young man, who had never seen one, objected by saying that he did not know how to do it, that the object held no meaning for him: "all I see are bars and holes" (von Uexküll 2010b: 94; cf. *above*, 120); after another person showed him how to do it, however, the young man had absolutely no difficulty. In *A Foray into the Worlds of Animals and Humans* Uexküll interprets the young man's learning process thusly:

> From then on, the sensorily given "bars and holes" took on a "climbing tone" for him and were recognized in all cases as a ladder. The perceptive image of bars and holes had been complemented by the operative image. Through this, it acquired a new meaning, and this meaning expressed itself as a new characteristic, as a performance tone [*Leistungston*] or operative tone [*Wirkton*] (von Uexküll 2010b: 94).

The appearance of operative images marks the achievement of a superior level of variety and environmental complexity. The behavioral flexibility they allow for opens up a wide range of possible actions for organisms – and, conversely, inserts numerous new objects into the environment endowed with use tones, that is to say, of meaning.

As we have seen, Uexküll believes that this process does not occur only in human beings, because a relative semiotic variability already exists in the environments of lower animals. As a careful reader of Uexküll like Merleau-Ponty would see, the hermit crab's use of the anemone for different purposes is already "a beginning of culture", "a species of preculture within Nature" (Merleau-Ponty 2003: 178). But it is the emergence of operative images in higher animals that brings us closer to the cultural sphere. It is significant that a large number of Uexküll's examples regard animals trained by man, as if to emphasize that operative images are present in nature (the case of the dragonfly for example), but it is human action which reveals all of their potential.

His particular "environmentalist" approach allows Uexküll to avoid any clear dividing line between nature and culture. For him, the progressive acquisition of faculties by organisms – where many authors base the affirmation of the fundamental heterogeneity or at least of the clear superiority of man over animals – does not count as much as the emergence in nature of ever richer and more complex environments. And if operative images are a characteristic trait of the most

articulate environments, their provenance matters little (in evolutionist terms and not Uexküllian ones, in what organism they developed and why). Instead, what will be greatly important is the specific contribution that operative images give to the great fresco of nature, enriching the possibilities for those particular "points of view on reality" which, for Uexküll, are species-specific environments. Uexküll believes that the introduction of operative images – sporadic at first in lower organisms, the more frequent in higher ones, finally systematic in the environment of man and of "his" animals (like dogs) – is the incontrovertible proof of the inexhaustible fecundity of nature (more than it is proof of the superior faculties of man).[7]

In the last chapters of *A Foray into the Worlds of Animals and Humans*, Uexküll introduces other advanced forms of environmental elaboration alongside operative images, all of which are theoretically common to higher animals and man. Some of the most interesting are the formation in the environment of familiar paths, dwellings and territories; the particular importance given to one or more conspecifics; the possibility that the environment can take on a particular "search tone"; and the emergence of magical or even hallucinatory elements or atmospheres in the environment. Although they are dealt with independently from operative images, these phenomena, in fact, are actually some of their specific applications: they foresee the possibility that the species-specific environment assumes particular "colorings" as a response to specific animal behaviors. We shall examine them one by one, with the intention of giving an idea of the peculiar "phenomenology of the environment" that Uexküll developed at the end of his career.

6.2.1 The Operative Space: Familiar Paths, Home and Territories

In the environments of numerous higher animals there are familiar paths, that is to say privileged routes within the environment that the animal has memorized in a stable and reliable manner. According to Uexküll's definition, the familiar path "works like a streak of a more fluid medium in a more viscous one [external reality]" (von Uexküll 2010b: 102), which continuously puts up resistance. The recognition of familiar paths by an individual animal occurs through a complex network of spatial and temporal coordinates, previously recorded perceptive marks (visual, tactile, olfactory) and self-produced stimuli which arise from the movements made by the subject. These movements, which Uexküll calls *orientation steps*, are based on the feeling of having taken one or two steps in a given direction.

[7]Uexküll's gradualist formulation was again well-received by Merleau-Ponty: with the increase in the closeness to man "the Umwelt is less and less oriented towards a [unique] goal and more and more interpretation of symbols. But there is not a break between the planned animal, the animal that plans, and the animal without plan" (Merleau-Ponty 2003: 178). On Merleau-Ponty's reading of Uexküll cf. Brentari 2010.

Something similar occurs in the environments of territorial species with the recognition of home and territory. As with familiar paths, home and territory are "exclusively subjective products" (von Uexküll 2010b: 103), environmental sectors in which interaction among perceptive marks, spatial and temporal coordinates and the "intuition" of one's operative space allow animals to be greatly effective in their action. According to Uexküll, one of the clearest and most representative examples of this is found with the territorial behavior of the mole:

> [The mole] has built its home and its territory. A regularly structured tunnel system spreads itself underground like a spider's web. Not only the individual passages, but the whole piece of ground they include are the mole's sovereign territory. [...] The ability with which the mole, a blind animal, can orient itself without fail in what for us is a completely homogeneous medium [the ground] is astounding. If it is trained to get its food at a certain spot, it can find this spot again even after all the passages leading to it are completely destroyed. This excludes the possibility that it can be guided by olfactory perceptive signs. Its space is purely an operative space (von Uexküll 2010b: 103–104).

In emphasizing the importance of orientation steps and the sense of one's operative space, Uexküll lays out a precise objective: to contest the validity of the experiments carried out by behaviorists using artificial mazes. According to him (and Lorenz shares his opinion, albeit in different terms) such experiments disrupt the network of the natural environment, leaving the animal in a neutral space which is devoid of meaning for it. Behaviorists look upon the animal as a subject without an environment and endowed with cognitive faculties that are functionally analogous to humans (though less powerful), that is to say they are applicable at will in any given situation[8]; instead, according to Uexküll the true capabilities of animals only emerge as *forms of possible interaction between the animal and the environment*. This does not exclude the possibility of training, which should, however, be understood as the gradual modification of the pre-existing cognitive relationship with the environment and thus presupposes a profound understanding of the entire ethology of the species being studied.

6.2.2 *Individual Recognition and "Companions" in Social Birds*

Now let us consider the second of the superior modalities of environmental elaboration listed above: the phenomenon of individual recognition of conspecifics. Thanks to both personal experience and the collaboration with Lorenz, in the chapter

[8] "For decades now, many American researchers have carried out thousands of series of experiments in which the most different kinds of animals had to find their way through a maze, in an attempt to establish how quickly each animal can learn a certain path. They never saw the problem of the familiar path that is concerned here. They never studied visual, tactile, or olfactory perceptive marks, nor did they consider the animal's application of the coordinate system; that right and left are a problem in and of themselves never occurred to them" (von Uexküll 2010b: 99).

dedicated to this issue in *A Foray into the Worlds of Animals and Humans* Uexküll is able to report a series of well-documented study cases. Beginning with the observation that among social birds, individuals often manifest strong attachment toward certain conspecifics, Uexküll focuses explicitly on two phenomena: the filial attachment that can originate between a newborn bird and an individual that does not belong to its species (a phenomenon which will gain great notoriety with Lorenz under the name *Prägung* or imprinting[9]) and the formation of individual bonds between an animal and single conspecifics (the so-called "companions"), with different functions in various stages of life.

Regarding the first phenomenon, Uexküll reports two examples: a young duck that follows a female turkey that brooded its egg, and a goose which followed Uexküll himself as if he were its mother. Without examining the possibility that such bonds were exceptional cases of a normally positive attachment dynamic, Uexküll is convinced that the explanation for the phenomenon should be explored "in a matter of confusing perceptive images" (von Uexküll 2010b: 108); specifically, by using the environmental categories he had previously established, he sees the imprinting directed on non-conspecifics as a kind of displacement of the operative image – the filter which, in this case, is responsible for selecting the object of filial attachment – and the perceptive material to which this is applied.

This hypothesis, which is presented cautiously and with the warning that the respective studies are incomplete, introduces notable empirical and theoretical drawbacks. Its main defect, which comes from Uexküll's own approach, lies in situating the link between the organism and the world in the transcendental sphere (which for Uexküll is perceptual as well as cognitive) without allowing the possibility of a pre-existing instinctive connection between the two poles. This possibility is not compromised by the indeterminacy of the object of the link (which at first glance seems incompatible with the concept of instinct): as Lorenz will show, the idea of an instinctual link with the external world certainly does not exclude the variability of the object that satisfies the instinct itself. In the case of imprinting, the instinctual link consisting in filial attachment presents a gap, so to speak, an empty space which (in the critical phase that follows hatching) can be filled by a multitude of variables (*cf.* for example Lorenz 1981: 279–284).

As far as the "companions" phenomenon is concerned, Uexküll's description is based initially on material sent to him by Lorenz in 1933. It is the same material that would appear in Lorenz's *Companions as Factor in the Bird's Environment* the following year – a work which, as mentioned earlier, is conducted with primarily Uexküllian terminology and theoretical tools. Lorenz analyzes many of the individual links present in social birds (particularly the jackdaw), and

[9] An even more direct reference to imprinting can be found in *A Theory of Meaning*: "The puzzling behavior of young grey geese, reported by Lorenz, also consists in *imprinting* meaning. [...] Even the human being can acquire the meaning "mother" for the grey goose in this case. "How does the human being imprinted as mother companion look to the grey goose?" is the question which particularly occupies Lorenz" (von Uexküll 2010b: 176).

discovers that, throughout its life, a bird can bond with many "companions", i.e. with conspecifics that make it possible for him to carry out certain functions or facilitate him in acquiring certain skills: the parent companion, the flight companion, the sexual companion. Referring directly to Uexküll, Lorenz states that the area of activity in which the individual bonds time by time with "companions" constitutes a separate functional circle. This also helps explain a phenomenon which initially appears quite enigmatic: the lack of individual recognition when an individual encounters a "companion" outside of the corresponding functional circle; in continued agreement with Uexküll, in Lorenz's *Companions as Factor in the Bird's Environment* functional circles are seen as separate perceptual and cognitive environments (on this phase of the relationship between Lorenz and Uexküll cf. *below*, 218–220).

In *A Foray into the Worlds of Animals and Humans* – completed in 1933, before *Companions as Factor in the Bird's Environment* had been published – Uexküll does not take full advantage of the consistency with Lorenzian ideas. Following a strategy of analysis that is very similar to what he applied to the case of imprinting, in speaking of "companions" Uexküll limits himself to emphasizing the importance of a correct interaction between perceptive image and operative image in the relationship with conspecifics. In particular, commenting on a case which Lorenz sent to him, in which a jackdaw chose the Austrian ethologist's chambermaid as a replacement sexual companion,[10] Uexküll states that:

> The conferral of an operative tone on a substitute companion has to make the later appearance of a true companion impossible. After the perceptive image of the chambermaid had received the exclusive "love tone" in Tschock's environment, all other perceptive images became ineffectual [...]. It is not the perceptive image alone which determines if it is a matter of a jackdaw or a non-jackdaw, but the operative image of the individual's own attitude. This alone can decide what perceptive image the respective companion tones receive (von Uexküll 2010b: 112–113).

This demonstrates how Uexküll's analysis of the individual link between conspecifics misses a fundamental point: he concentrates on the potential wrong applications of the individual link, without seeing the positive possibilities that it brings (in the case of imprinting, a filial link that is much more solid than in species lacking in individual recognition). It almost seems as if, when confronted with Lorenz's material, Uexküll is fascinated with the pathological cases, by behavioral dysfunction, and thus neglects normality.

A possible explanation for this attitude might be traced to the fact that, in the teleological and "hyper-harmonious" context of Uexküllian theoretical biology, dysfunction often appears as an enigma. In other words, Uexküll is unable to explain how it is possible that an essential behavior such as reproduction could

[10]The famous jackdaw Tschock, who is found in the early writings of the 30s (*cf.* Lorenz 1931: 13–69), as well as in the popular book *King Salomon's Ring* (Lorenz 1961: 45–86). For the episode concerning the chambermaid *cf.* Lorenz 1961: 50.

be left "undetermined" in such a basic issue as object individuation. For such a staunch supporter of the overall finalism of nature who usually tends to silently pass over the potential for misunderstanding or error in the relationship between animals and environment, the "error" of the goose that follows a man is a mysterious and fascinating phenomenon. Being unable either to deny or to explain it without compromising his theoretical suppositions, Uexküll confines himself to describing it and labelling it as erroneous, a discrepancy between perceptive image and operative image.

It is important to note that this problem does not exist in the Lorenzian theoretical context. Lorenz sees imprinting and companionship bonds as forms of instinctive behavior which are very efficient from a selective point of view but, at the same time and like any new evolutionary trait, "risky" and liable to error. His interpretation, which today is almost universally shared, considers the behavioral acquisitions of social birds as an emblematic case of the way in which natural evolution proceeds: from a casual mutation of behavioral repertoire (individual recognition) we get a non-programmed creation of social structures, which if they turn out to be positive are maintained and transmitted to future generations, otherwise they disappear. The absence of initial programming – and this is what Uexküll cannot allow – does not, however, exclude that the same structures could have negative aspects from an evolutive point of view (such as the "false attachments"), and could be harmful in a changed situation (such as captivity, which usually makes imprinting on non-conspecifics possible). Incidentally, it is for the same reason – i.e. his finalistic conception of nature and his refusal of evolution by natural selection – that Uexküll was never able to understand the normal, and not exceptional, character of the extinction of species. In other words, his aprioristic affirmation of harmony that reigns between animal and environment (the theory of *Einpassung*) does not allow him to see how the extinction of certain species is nothing more than the flipside of the acquisition of new anatomical, physiological and behavioral abilities by other species.

6.2.3 The Search Tone

As we have seen, Uexküll's environmental theory foresees that specific environmental circumstances or certain elements of the environment can assume special colorings (the escape tone, the feeding tone). Among the possible colorings of the environment, we find the search tone (*Suchton*), which Uexküll places among the superior environmental expressions opened up by the availability of operative images. As happens with familiar paths, imprinting, etc., the search tone also does not affect the perceptual content that it invests, but rather influences its meaning, its significance for the action in progress.

To summarize, Uexküll considers the environment assumes a search tone when what is important within it is the *absence* of a certain object, which is to say the object searched for; this presupposes that there is the perceptive image of the

object in the mind of the subject (human or animal), even in the absence of that object. Uexküll calls this the *search image*. Let us see one of the examples used to demonstrate this idea:

> When I spent a while as a guest at a friend's house, an earthen water pitcher was placed at my place at table every day at lunch. On day, the butler had shattered the clay pitcher and, instead, placed a glass carafe in front of me. When I looked for the pitcher during the meal, I did not see the glass carafe. Only when my friend assured me that the water was in its usual place did different sparkling lights scattered on knives and plates shoot through and come together to form the carafe. [We can synthetically describe] this experience: the search image wipes out the perceptive image (von Uexküll 2010b: 113).

The search image projects a particular aura of insignificance upon all non-relevant perceptive images, and in this way relegates the contribution of the perception itself to the background (a process which Uexküll defines "deactivation"). This phenomenon is often useful for the search activity, but can be deceptive in the case of a change in the environmental situation; our search image will no longer correspond to the possibilities offered by the environment. When we realize that we are using an inadequate "filter", perceptions leave the state of deactivation and return to the foreground, with subjective effects that "seem like witchcraft" (von Uexküll 2010b: 114).

According to Uexküll search images are already present in the behavioral repertoire of animals. To confirm this, he mentions the case of the toad which, after having eaten a number of earthworms, threw itself ravenously on a match as well; here the recent image of the earthworm cast a specific search tone on the environment, which not only attributed sole importance to the forms which were searched for, but asserted itself over perceptive reality, making the toad disregard the perceptual differences between match and earthworm. The dog, too, fetching a stick thrown by its master follows a precise search image; and it is also possible for the dog to be deceived by an environmental feature similar to the stick.

In the environment of man, the phenomenon of search tone and search images is clearly present. This is due to the fact that, for man, the objects' functions are also part of the felt environmental components; the search that man carries out, in other words, is based not so much on a precise image as it is on functional requirements that, although well-defined in themselves, can be possessed by a multitude of environmental elements. As Uexküll writes,

> we do not by any means always search for a certain object with a unique perceptive image, but far more often for an object that corresponds to a certain operative image. We do not look around for one particular chair, but for any kind of seating, i.e., for a thing that can be connected with a certain function tone [*Leistungston*] [. . .]. The hungry toad goes searching for food at first only with an unspecific feeding tone. Only after it has eaten a worm or a spider is this tone accompanied by a determined search image (von Uexküll 2010b: 117).

In these cases it is not so much the lack of an object which acts as a search impulse as it is the absence of an object function; the organism moves from the need to carry out an action (to sit, to eat) and the environment colors itself in such a way as to emphasize only those objects capable of satisfying that need.

Following the general structure of *A Foray into the Worlds of Animals and Humans,* Uexküll holds that the search tone phenomenon not only involves the environment of man but also certain animal environments; and, in the same way as the one seen for operative images in general, the research tone also corresponds to an elevated behavioral plasticity. It is worth noting how in Uexküll's environmental analysis the search tone corresponds on a functional level with the behavioral modality that Lorenz defines as explorative behavior and describes as a constant habit of research and "classification" of environmental elements. Like Uexküll's search tone, Lorenz's explorative behavior does not belong solely to the human species but is present in other animals as well (rats, corvids, etc.).

Once again, however, what divides the two scholars is the explanation of the phenomenon. In Uexküll, the assumption of the search tone by the whole of the environmental elements is the consequence of the overall teleology which regulates the relations between organism and environment. In Lorenz, the explorative behavior is the result of evolution by natural selection of behavioral traits which have emerged by chance among different species. This difference in their fundamental theoretical programs puts Lorenz ahead of Uexküll's conception of search tone on an extremely important point. According to Lorenz, the explorative behavior is not only motivated by a specific need (such as hunger); but by anticipating the rise of necessities, it often "categorizes" the highest number of possible environmental elements that may prove useful. Lorenz's observation is made possible by a harder and more disenchanted – but also more open and dynamic – conception of the relation between organism and environment than Uexküll's. In a context which, similarly to Lorenz's, is dominated by the contingency of the absence of pre-established harmony, the organism which "prepares itself" for environmental challenges by taking in the highest amount of information from the environment certainly has higher probabilities for survival and reproduction.

6.2.4 Magical Environments

The final higher environmental elaborations that Uexküll describes in *A Foray into the Worlds of Animals and Humans* is the formation of "magical environments". This phenomenon consists in the presence of hallucinatory elements, which are assigned objective reality, within the usual, already established species-specific environment. Before proceeding with the explanation, it is important to mention that again Uexküll alternates between examples drawn from the animal world and study cases coming from the human sphere. And, given the nature of the phenomenon, the cases from the human sphere come from disciplines such as folklore, infant psychology and anthropology.

Let us examine one of the more relevant cases involving a magical environment in human experience:

> Frobenius tells in *Paideuma* about a little girl who played the story of Hansel and Gretel, the witch, and the gingerbread house with a matchbox and three wooden matches quietly until she suddenly exclaimed, "Get the witch out of here; I can't stand to see her repulsive face any more!". [In] this typically magical experience [. . .] the evil witch appeared in the flesh in the little girl's environment (von Uexküll 2010b: 119; cf. Frobenius 1921: 59).

The assigning of reality to the appearance of the witch is different from the normal constitution of environments – although this, too, is a subjective transcendental process – for two main features. The first is that it is not a species-specific constant: the hallucinatory interpretation of perceptive elements that bring about the constitution of the environmental element "witch" occur only in particular individuals. The second is that the appearance of the witch does not begin from an external stimulus: the available stimuli are normally constituted in the environmental object "box of matches" and there is nothing in this which demands or induces the extra elaboration of the "vision" of the witch. As a consequence of this phenomenon – which Uexküll believes is typical not only in childhood but also in primitive cultures and even "in the environment of cultivated Europeans" – "fantastic phenomena blend with the sensually given things of their world" (von Uexküll 2010b: 120).

Uexküll states without giving any further explanation that magical environments are the privileged seat of cognitive processes and behavioral modalities which refuse the usual rational logic based on the principle of identity and causal links. In animals, the presence of alogical environmental components is particularly evident in the experience of dogs: "The role played by the master in the dog's environment" – writes Uexküll – "is surely grasped magically and not divided into cause and effect" (von Uexküll 2010b: 120).

One of the clearest examples of environmental magic – or better of the magical appearance of an environmental component – is sometimes found in the predatory behavior of the starling (*Sturnus vulgaris*). This case study, which Uexküll learns of through correspondence with Lorenz, and which would enjoy in later years significant popularity thanks to the spread of ethology, is described thusly:

> A researcher who was a friend of mine [Lorenz] reports on a doubtlessly magical phenomenon in the environment of a bird. He had raised a young starling in a room, and the bird had no opportunity ever to see a fly, much less to catch one. Then he observed that the bird suddenly started after an unseen object, snapped it in the midair, brought it back to its perch and began to hack away at it with its beak, as all starlings do with the flies they catch, and then swallowed the unseen thing. There was no doubt as to the fact that the starling had the appearance of an imaginary fly in its environment. His whole environment was evidently so laden with the "feeding tone" that, even without the appearance of a sensory stimulus, the operative image of flycatching, poised to spring, forced the appearance of the perceptive image, which triggered this whole sequence of actions (von Uexküll 2010b: 120–121).

Lorenz's observations about the starling's behavior, which date back to the early 30s, are found in the article *A consideration on methods of identification of species-specific instinctive behaviour patterns in birds* (Lorenz 1931: 93). Lorenz considers

it a case of instinctive behavior, the so-called "vacuum" behavior (*"auf Leerlauf"*); in his terminology innate motor modules are considered "vacuum" when, because of accumulated drive energy (in this case connected to the hunger stimulus), they can be activated even without the external stimulus which normally triggers them. In terms of the subjective experience of the animal that carries out the vacuum action, which is the most interesting aspect for Uexküll, Lorenz is much more cautious in hypothesizing whether the subject indeed perceives the triggered stimulus (in this case, that it really sees a non-existent fly). Lorenz limits himself to stating that "when observing such behaviour, one is immediately conscious of the question as to what subjective phenomena are experienced by the animal, since this behaviour is so reminiscent of that of certain human psychopaths who experience hallucinations" (Lorenz 1931: 93; on the different interpretations of the starling case study by Uexküll and Lorenz *cf.* Brentari 2009: 206–207). Uexküll, who believes that animal behavior cannot be separated from an environmental correlate, is instead entirely convinced that the "transcendental reality" of the magical element is what triggers the starling's action.

Uexküll also turns to the notion of the magical environment, and the appearance of hallucinatory elements, to explain the migratory behavior of birds:

> The same is true for the flight path of migratory birds. The continents bear the inborn path, one visible only to the birds. [. . .] As with the familiar path, which we have discussed at length, the inborn path will also lead through visual space as well as operative space. The only difference between the two lies in the fact that, with the familiar path, a series of perceptive and operative signs that were established through previous experiences follow one after the other, while, with the inborn path, the same series of signs is immediately given as a magical phenomenon (von Uexküll 2010b: 122).[11]

In the case of migration the magical element would not be limited to triggering the action but would guide it step by step; according to Uexküll, therefore, the magical path would constitute an environmental reality as real as the mountains and the seas which the birds fly above. It would be a kind of lasting hallucinatory overlapping which – being "guided by a plan at the highest degree" (von Uexküll 2010b: 124) – leads the birds to a destination even in the absence of previous experience.

6.2.5 The Environment of Man: The Emergence of Intraspecific Variability

The superior environmental traits linked to the operative sphere – familiar paths, imprinting, the search tone, magical environments – clearly highlight what Uexküll perhaps considers the principal characteristics of environments in general, that

[11]To describe the presence "in the mind" of such stimuli, Uexküll again turns to a musical metaphor: they "sound one after the other like an inborn melody" (von Uexküll 2010b: 124).

is to say their subjective and transcendental nature. As we have shown, they represent a sort of secondary elaboration of species-specific environments; if these environments are established in a fixed manner and cannot vary in any substantial way, the superior traits, instead, prove to be much more free, both in terms of initial stimuli and in terms of individual variability.

As the subjectivity of species-specific environments is further expanded by secondary elaborations, in *A Foray into the Worlds of Animals and Humans* Uexküll finds himself inevitably facing the objection that subjectivity of the environments may compromise their correspondence with reality. His response to such an objection, which is strategically located at the end of the chapter on magical environments, is brief but assertive:

> There are thus purely subjective realities in environments. But the objective realities of the surroundings never appear as such in the environment. They are always transformed into perceptive marks or perceptive images and equipped with an operative tone which only then makes them into real objects even though no part of the operative tone is present in the stimuli. [. . .] In this way, we then conclude that each and every subject lives in a world in which there are only subjective realities and the environments themselves represent only subjective realities (von Uexküll 2010b: 125–126).[12]

As Mazzeo highlights in the note for this citation (von Uexküll 2010a: 149), the reality that pertains to species-specific environments can be understood only if one keeps in mind that, in order to describe it, Uexküll uses the German term *wirklich*: this term, normally translated with "real" or "actual", has the same root as *wirken*, "act effectively", "cause an effect". The ontological status of environments and their components is not therefore "material" or "objective" reality, but rather actual reality (*Wirklichkeit*): environments are real inasmuch as they act effectively on the subject. However, at the same time – given the absence of any resemblance between stimuli coming from external reality (the "surroundings", to use Mazzeo's terminology) and the environment which is created starting from those stimuli – environments are at the same time transcendental productions whose responsibility falls entirely on the subject itself. Here we find a dangerous circularity: the environment that acts on the subject is born from that very subject's transcendental production activity. This is the basis for the most serious criticism made against Uexküll by many interpreters (Lorenz above all; *cf. below*, 222; Brentari 2009): the subject becomes enclosed in an insurmountable perceptive and operative circle whose agreement with the external reality and other environments is guaranteed only by the general teleology of nature (and therefore is not at all guaranteed for those who do not believe in such a teleology).

[12] *Ibi*, pp. 125–126. With the term "surroundings" (Italian: "dintorni") Mazzeo translates the German *Umgebung*, which in the Uexküllian lexicon indicates the physical context that, on a case-to-case basis, supports the establishment of subjective *Umwelten* (environments). Not even the *Umgebung*, however, is an objective reality in the strictest sense: it is the specific environment which man has access to when he adopts the point of view of science. The same translation of the German term can be also found in von Uexküll 1985.

Besides revealing the general subjectivity of environments, the complex phenomena to which Uexküll dedicates the last paragraphs of *A Foray into the Worlds of Animals and Humans* also introduce a number of peculiar traits which cannot be reduced to the properties of inferior environments. It is on these traits that we shall now linger, with the intention to better understand the environment of man. As we have seen, superior environmental phenomena make it possible for individual elaboration of the species-specific environment to emerge in nature:

> Until now, environments had been the product of the perceptive signs that were awakened by external stimuli. But the search image, the tracing of the most familiar path, and the demarcation of the territory already constitute exceptions to this rule, since they could be ascribed to no sort of external stimuli but represented free productions of the subject. These subjective productions had developed in connection to repeated personal experience of the subject (von Uexküll 2010b: 119).

As shown above, the exceptionality of free subjective elaborations should not be read as a statement of the unicity or superiority of man and its environment. On the contrary, the increased individuality and originality that those elaborations make possible occur without radical fractures with the inferior levels; the way Uexküll treats this topic – through a skilled counterbalance of examples from the animal world and from the human sphere – reveals the conscious intention to underline the continuity between animals and humans.

If this is true, and if it is true that Uexküll generally supports a gradualist conception of the relationship between humans and animals, yet it should be said that (in Uexküll's conception as well) in the environment of human beings there is a sort of leap in quality. In human perception, the transcendental constitution of environments and action depend on individual variables in a measure unequaled in the rest of the animal kingdom. In other words, for different human subjects the same environmental element can assume an utterly different meaning, and can thus confer a different coloring to the environment. Uexküll's favorite example of this is based on the interpretative relation that different people can have regarding a tree, an oak in particular:

> In the thoroughly rational world of the old forester, who must determine which trunks in his forest are ready to be felled, the oak [. . .] is no more than a few cords of wood, as the forest attempts to establish through precise measurement. In this case, no further attention is paid to the bulging bark which resembles a human face. [. . .] [Let us consider] the same oak in the magical environment of a little girl whose forest is still filled with gnomes and sprites. The girl is terribly scared as the oak looks at her with its wicked face. The whole oak has become a dangerous demon (von Uexküll 2010b: 128).

The semantic and phenomenological variety that unfolds around the same element makes mean that human environments are subjected to an elevated intraspecific variability,[13] besides the normal interspecific differences. Even though he

[13]This point was well-understood by Medard Boss, who – in discussing the extreme variety of the subjective experiences of human beings from a psychoanalytic-existential perspective – in regards to Uexküll states: "Although, because of some biologic misunderstanding, this author cannot yet fully differentiate between the rigidly prescribed animal world and the more or less free world of

sometimes acknowledges and even sometimes emphasizes that variability, Uexküll tries to present it as a specific case of the general variety of environments inasmuch as they are subjective products (hence he avoids assigning man with a privileged status). In his theoretical framework, in other words, the perceptual and cognitive diversity which exists between the forester's environment and that of the little girl's in connection with the object "oak", does not seem to present specific problems. Uexküll deals with this diversity as if it were entirely analogous to the difference in how a fox and a squirrel "interpret" the oak and give it a different meaning. The following statement is particularly relevant:

> For the fox, who has built its den among the oak's roots, the oak has become a solid roof which protects it and its family from the perils of weather. The oak possesses neither the use tone from the forester's environment nor the danger tone from the little girl's environment, but only a protection tone. [. . .]. For the squirrel, the oak, with its many branches offering handy springboards, takes on a climbing tone, and for the songbirds, which build their nests in the remote twigs, it offers the needed carrying tone (von Uexküll 2010b: 130).

Realizing perhaps this weakness, Uexküll attempts to support his "uniforming" approach with examples intended to prove the existence of environmental intraspecific variability among animals as well. Specifically, Uexküll advances the idea that imprinting on non-conspecifics in certain species of birds and the ability of guide dogs to grasp the meaning of environmental elements which are useful for humans can be seen as two cases of an individual modification of the regular species-specific environment. Although praiseworthy in their intention to avoid insurmountable divisions between man and animal, neither Uexküll's "assimilatory" strategy nor the examples he chooses to reinforce it are objection-free.

First of all, the two examples that Uexküll uses to demonstrate intraspecific variability in the animal world look at domesticated animals (such as imprinting on non-conspecifics) or trained animals (the case of the guide dog). In both cases, it would not be an exaggeration to say that the assumption of "individual" meanings on the part of environmental elements that are usually neutral is a product of the modeling action of man on animals, more than a spontaneous and gradual increase in the complexity of the environment-organism system. If this is true, it is also true that the positive response of animals to human-induced behavioral and cognitive modification shows that in the animal kingdom there is at least the potential for individual elaboration of the environment (and thus untapped possibilities for non-human paths toward culture). Until now, however, the concrete fulfilment of this potential can be found only in man.

Second of all, Uexküll's overall strategy does not take into account an extremely relevant difference between the environments of animals and that of man: the

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man, he has demonstrated that there are vast differences in perceiving one and the same object of the world by various kind of animals. But he also has pointed out how differently an oak tree in the woods is observed and experienced by a hunter, a romantic young girl or a practical lumber dealer" (Boss 1949: 31). Boss adopts the example of the oak as presented in *Theoretische Biologie* (von Uexküll 1928a: 232), which has some slight differences with the one used here, which comes instead from *A Foray into the Worlds of Animals and Humans*.

extraordinary inclusivity of the latter. This does not only refer to the interest that man shows towards other animals' environments (which often translates in the truly pre-philosophical question "how does an animal see the world?"), but also to man's wish to distance himself from his own species-specific environment, to break the innate perceptive limits of his own anatomical and physiological endowments and to reach something that is no longer a species-specific environment: the world as an amalgam of objective and universal facts, the final destination of the cognitive endeavor of science and western thought.

Uexküll attempts to show man's tendency to expand his sphere of experience and action as a capacity that, actually quite naturally and consistently with what other species do, brings about the formation of new subjective environments which are increasingly ample. In the "Conclusion" of *A Foray into the Worlds of Animals and Humans* he uses the environments of scientists belonging to different disciplines (astronomer, oceanographer, chemist, physicist, etc.) as normal examples of environmental variability, meaning the results of the individual subjectivity of the scientist who perceives, knows, and elaborates hypotheses and theories. This approach is problematic for multiple reasons. Not only does it neglect – or at least implicitly declare illusory – the conscious will of the scientist to find an objective and universally shared truth, but it will also result in the complete equivalence of results from individual research, which cannot be verified with reference to anything extra-subjective.

The clearest example of this disadvantage is provided by Uexküll himself in the conclusion of *A Foray into the Worlds of Animals and Humans*. One of the examples of "environmental irreconcilability" among scientific disciplines is the rift between behaviorism and psychology concerning the problem of the relationship between mind and body. Uexküll writes that this problem should be posed in these terms:

> In the behaviorist's environment of Nature, the body produces the mind, but, in the psychologist's world, the mind produces the body. The role Nature plays as an object in the various environments of natural scientists is highly contradictory. If one wanted to sum up its objective characteristics, only chaos would result (von Uexküll 2010b: 135).

Clearly, if, like Uexküll, we start from the principle that subjective environments are equal, no one can refute (or confirm) other positions. The environment of the subject also conditions the scientific adopted approach, and this makes different properties and characteristics of the external reality emerge in the studied object.[14] Possible contradictions – which are inevitable, given the plurality of subjects – must simply be tolerated. Obviously, neither the behaviorists nor the psychologists would agree to leave such a fundamental problem unresolved in the name of natural environmental variability and of the subsequent cognitive relativism. Furthermore,

[14]Here we have a curious similarity with the stance of Protagoras, who believed that man's gnoseological relativism (starting from a sensory level) would be justified by the simultaneous presence in reality of all the different properties and nuances felt by subjects: "matter, so far as depends on itself, is capable of being all those things which appear to all" (Sextus Empiricus 1976: 131).

considering the strong criticism Uexküll directed at his scientific adversaries in other passages, it is hard to picture him as fully satisfied with this relativistic solution.

Contrary to what Uexküll believes, therefore, the intraspecific variability and conscious distancing desire from the subjective environment (both the species-specific and the individual ones) are features which necessarily result in the qualitative differentiation of man from all other animals. Even allowing that the final outcome of scientific knowledge is nothing but a particular subjective environment that is deceptively declared objective and universal, we would still need to explain why man and only man follows this particular path – the path of the illusion of universality – in the transcendental constitution of his environment.

A Foray into the Worlds of Animals and Humans ends with a stance which, despite proving inevitably disappointing for scientists and those who share a scientific view of the world, shows how Uexküll was entirely aware of the problems raised by his own environmental subjectivism and how he attempted to find a solution by turning to the intuition of nature as a unifying and interconnected organism. "And yet [despite their potential contradictiveness], all these different environments are fostered and borne along by the One that is inaccessible to all environments forever. Forever unknowable behind all the worlds it produces, the subject – Nature – conceals itself" (von Uexküll 2010b: 135). In Uexküll's idea, turning to nature as a macro-subject would reduce the contradictiveness of environments to a perspective effect: the contradictiveness of the scientific sphere and the cognitive sphere in general would indeed continue to depend on different (and all equally legitimate) environmental interpretations provided by various subjects, but would disappear if the entirety of environments were considered as the product (unfortunately inaccessible to our mind) of a single original subject, nature.

6.3 The Theory of Meaning

Our analysis of *A Foray into the Worlds of Animals and Humans* has often brought us to consider the theme of meaning as an environmental phenomenon. Specifically, it has been shown how the increase in environmental complexity in higher animals and man brings about on one hand the specification of the meaning of particular environmental elements within a larger class (as is the case of individual recognition in social animals), and on the other the increase in semantic variability of a single environmental element for different subjects (think back to the "environmental experience" of the forester and the little girl with the oak). It is not surprising, therefore, that a few years after *A Foray into the Worlds of Animals and Humans* Uexküll dedicated a work specifically to meaning, entitled *A Theory of Meaning* (von Uexküll 1940; English edition used: von Uexküll 2010b: 136–208). This work, which was written in 1940, was published together with the second German edition of *A Foray into the Worlds of Animals and Humans* (von Uexküll and Kriszat 1956). Thanks mainly to the popularity of *A Foray into the Worlds of Animals and Humans*,

the joint publication (with an excellent preface by Adolf Portmann) would see four editions; this helped the circulation of *A Theory of Meaning*, which has a more technical writing style. Although these two works could be published together due to their thematic similarities, it is important to note that, in terms of presentation and interpretation, the different genesis of *A Theory of Meaning* makes it possible to treat them separately; which is the strategy that we shall adopt in our work as well.

From the very beginning of the elaboration of his environmental theory, Uexküll's view is that the relationship that binds an organism to its environment is never immediate or automatic: between the reception of stimuli and organism's response there is space for an activity of interpretation or elaboration of the stimuli themselves. In other words, in the Uexküllian conception of the relationship between living things and matter (or other living things), the idea of the sense-endowing of the stimuli themselves is central.

Before moving on to analyze the modalities with which that interpretative process is considered in *A Theory of Meaning*, it is necessary to make a clarification. The statement that an organism moves in an environment endowed with sense, or even constituted by meanings, does not imply that the organism is necessarily aware of these meanings. Between the two extremes established on one side by the automatic reaction to the stimulus (and the behaviorist and Pavlovian conception of behavior is based on the generalization of this), and on the other by the awareness of one's own conduct (usually attributed to man) there is an intermediate space. In Uexküll's belief, this space is extremely wide and could be defined as *the biological phenomenon of the unfelt sense*. As Merleau-Ponty would emphasize, the Uexküllian conception of environment is a valid corrective to the hidden Cartesianism in biology and modern psychology especially, which tend to deny that the environment could have sense unless that sense is conscious, that is to say *symbolically reproduced* on a mental level.

As we have seen, one of the first appearances of the notion of stimuli interpretation is found in the first edition of *Umwelt und Innenwelt der Tiere*; in this work Uexküll states that receptors have the task of transforming the stimuli coming from the external world into quanta of excitation, and that those quanta were therefore signs of the external event causing the stimulation. This establishes a language of signs of nervous nature; those signs say nothing of the quality of the stimulus and can be differentiated and elaborated distinctively only if a single nerve is loaded with a single quality. Therefore, there is no mirroring of exterior reality, what occurs instead is a sort of cataloguing of environmental stimuli through the assignment of "messages" to different bundles of nerve fibers – which in this phase are described as "schemata" that are of a physical nature and are active in the inner world off the animal (von Uexküll 1909: 250).

If the idea of an immediate connection between an effect (the reaction) and a physiological cause (the stimulus) is clearly refused here, and the intention to underline the process of translation of the inputs which physically derive from the external reality in an interior language is as much clear, the danger connected to this concept must yet be highlighted. If, as Uexküll writes, the process of stimuli translation has nothing to do with the external events, then the organism risks

remaining closed within itself. Moreover, it is not clear how the outcome of that process (the translated message, so to speak) could guide animal behavior in an effective and adequate manner in the situation; or rather, it is not understandable if you do not take Uexküll's finalist context into consideration, in which it is easy to turn to supersensible factors that predetermine the harmony of the organisms' individual relationships and those between organisms and the environment. In the years following his first formulation in the first edition of *Umwelt und Innenwelt der Tiere*, the idea of "translation" of external reality into environmental elements endowed with meaning remains constant in all of his main works, without particular emphasis though; this only occurs in *A Theory of Meaning*, which we will now examine in more detail.

Following the line of critique expressed in *A Foray into the Worlds of Animals and Humans*, also in *A Theory of Meaning* Uexküll clearly mentions his scientific adversaries – in particular Loeb and the American behaviorists. As regards Loeb, Uexküll questions mainly his excessively ample use of the notion of tropism in biology. By tropism, Loeb means an elementary movement of approach or evitation that is triggered in an organism by the reception of a stimulus; one of the most notable examples Loeb provides is the reaction of approach that certain plants have towards a source of light (positive phototropism). In Loeb's work, tropisms become the keystone of all animal and plant biology; every kind of behavior, including the entirety of higher animal behavior, is attributed to the action of specific tropisms (von Uexküll 2010b: 161–162).[15] But in doing so, Uexküll believes that, "Loeb declares these simple spatial components of each action [approaching or moving away] to be the action itself" (von Uexküll 2010b: 162).

Further, Uexküll states that in Loeb's idea the organism has relations with its environment that are exclusively physio-chemical, so that "one object affects another like the hammer on the anvil or the spark in the powder keg" (von Uexküll 2010b: 162).[16] In this "environment" reduced to a series of elementary causal connections there is no space for any semantic elaboration of the stimulus by the subject. Using his own categories, Uexküll states that, for Loeb, there is no perceptive world but only an operative one, or rather a combination of causal influences that determine the behavior of organisms in a mechanical, automatic way.[17] In short, in *A Theory of Meaning* tropism becomes the archetype of a stimulus-reaction relationship that, after being extrapolated from its legitimate

[15]This leads to instances of baroque complexity, such as when magnetic attraction toward metal is defined as "ferrotropically positive behavior" (von Uexküll 2010b: 162).

[16]Loeb's model of living things shares a strong similarity to Descartes; here, too, the impact between physical objects becomes the paradigm of the relationship between the organism (as perceiving object) and the environment, and reflex behavior (triggered automatically by the stimulus) becomes emblematic of all animal behavior. This issue will be dealt with in detail in the paragraph dedicated to the critique that Merleau-Ponty – using Uexküllian categories – addresses to behaviorists and Pavlovians (see *below*, 212).

[17]For simplicity's sake here Uexküll neglects the fact that, in his conception, the operative world is also based on an interpretative process (see *above*, 108–110).

context (the physical world), is unduly projected onto the living thing. Therefore, the critique of Loeb's conception can also be extended to all scientists who are guilty of a similar simplification, Pavlov and the American behaviorists above all. With regards to them Uexküll pulls no punches:

> If we take into consideration the progress of biology in the last decades, insofar as they stood in the wake of "behaviorism" or "conditioned reflex", we can safely say that experimental practice has become more and more complicated, whereas the thought process has become simpler and cheaper ((von Uexküll and Kriszat 1956: 161).

Now that the recipients of the author's critical intent have been identified, let us turn now to the conception of environment Uexküll develops in *A Theory of Meaning*. This work fits in with his biological-theoretical reflection carried out in previous works (primarily in *Umwelt und Innenwelt der Tiere* and *Theoretische Biologie*, but also in *A Foray into the Worlds of Animals and Humans*), but it also rereads Uexküll's pre-existing concepts and hypotheses under the new light of a *theory of meaning*. This theory resolves to overcome another serious limit of behaviorism and mechanism in general, which is the oft unspoken supposition that an animal could enter into relation with any object that is physically present in its vicinity. This supposition, which according to Uexküll lies at the base of the factitious laboratory experiments conducted mainly in America during the first half of the twentieth century, must be corrected by a radical rethinking of the very concept of the object (*Gegenstand*).

Uexküll notes that it is possible only for man to have a "neutral" relationship, so to speak, with an object, a relationship of pure observation; and for man, too, objects are mainly invested with a well-defined value connected with the situation. The object is consequently a *meaning carrier* (*Bedeutungsträger*); this is almost always true in the environment of man, and without exception in animal environments. As Uexküll notes,

> the stone, which lies as a relationless object in the hand of the observer, becomes a carrier of meaning as soon as it enters into a relationship with a subject. Since no animal ever appears as an observer, one may assert that no animal ever enters into a relationship with an "object" [in general]. Only through the relationship is the object transformed into the carrier of a meaning that is impressed upon by a subject (von Uexküll 2010b: 140).

Taking the stones which pave the road as an example, Uexküll states that, in the perception of the subject, their normal condition is that of being invested by a "path-quality [*Wegton*]". If, however, as we are walking along the road we are attacked by a dog and defend ourselves by throwing one of those stones, something peculiar happens:

> Neither the shape, nor the weight, nor the other physical and chemical properties of the stone have changed. Its color, its hardness, its crystal formations have all stayed the same – and yet it has undergone a fundamental transformation: it has changed its *meaning*. [. . .] It had acquired a throw-quality [*Wurfton*] (von Uexküll 2010b: 140).

In *A Theory of Meaning* what Uexküll calls "tone" can thus be defined as the *situation value* that an object takes on for a certain subject at a given moment. The possibility that an object assumes different meanings, in other words, supposes the

presence of distinctive traits in the object that "carry on themselves" a meaning on a case-by-case basis, and in the subject the disposition to receive that multiplicity.

The external reality is therefore polysemous and (at the same time) indeterminate; only the encounter with the subject clarifies its sense:

> As soon as the object appears as a carrier of meaning on the stage of life, each component of an organic or inorganic object is brought into connection with, let us say, a "complement", in the body of the subject, which serves as a consumer of meaning (von Uexküll 2010b: 143).[18]

In general, Uexküll specifies, the things which are found in the immediate vicinity of an animal may encounter two different fates: if they have no relevance to the environmental economy of the subject they are "completely neglected"; in the opposite case

> anything and everything that comes under the spell of an environment is either redirected and re-formed until it becomes a useful carrier of meaning. [...] Thereby, the original components are often crudely torn apart without the slightest consideration for the structural plan which controlled them to that point (von Uexküll 2010b: 144).

The meaning, or better meanings, of which the object is the potential carrier, thus become integral parts of the functional circle in which the subject is a part. For animals, the overall structure of the object – which is visible to man thanks to his capacity to exercise pure observation – has nothing more than the function of "an undifferentiated counter-structure [*Gegengefüge*]" (von Uexküll 2010b: 146) which holds the significant elements of the object together without appearing on the perceptual plane or being involved in the action.

The centrality that the concept of meaning assumes in *A Theory of Meaning* brings Uexküll to reconsider the existence of living organisms as a continuous valorization of meanings. In this light, a ranking of semantic receptivity by living things can be drafted: the reperceived meanings, in other words, is minimal in plants, sees a significant increase in animals and is at its highest in man. Besides being able to assume the role of disinterested observer (and thus to "valorize" object components that are different from those that fall into the functional circle of feeding, reproduction, and self-preservation), human beings can also understand the meaning that an object component assumes for other human beings and other living organisms.

In the semiotic perspective that Uexküll adopts in his 1940 work, animals are capable of unifying different signifiers that (within their functional circles) come into play into the same object (that is to say the operative and perceptive marks), but this unifying occurs more on a behavioral plane rather than on that of cognitive ability. In full agreement with the fundamental system of Uexküllian biosemiotics, in other words, the consistency of the meanings reperceived by the subject with

[18] As Buchanan rightly states, the attribution of meaning (or rather the inclusion of an animal species in the semiotic environmental system) concerns at least three categories of entities: other living beings, lifeless things and "inorganic *forces* – such as affects, temperatures, shadows, or noises" (Buchanan 2008: 36).

the significant features of the object (understood as a part of external reality) is guaranteed by the overall finality that regulates the life cycle of every organism. This fundamental consistency between organism and environment is highlighted by systematically using the explicative potential of the metaphor of melody, a metaphor occasionally used in previous works.

> As, in the composition of a duet, the two voices have to be composed for each other note for note, point for point, the meaning factors in Nature stand in a contrapuntal relation to the meaning utilizers. We will be closer to understanding the form development of living beings when we succeed in deriving a *composition theory of Nature* from it (von Uexküll 2010b: 171).

In *A Theory of Meaning* the most articulate example of the counterpoint relationship between animal and environment is represented by the feeding behavior of the tick. The case study of the tick had already been used by Uexküll as an emblematic case of the schematic character and perceptual paucity that functional circles of lower animals can have. In *A Foray into the Worlds of Animals and Humans*, the tick's capacity to wait for a specific environmental element for years is underlined; once that element presents itself (the smell of butyric acid emitted by a mammal that passes under the tree where the tick is) the functional circle of feeding begins. During the waiting period, Uexküll holds that the tick is suspended in a sort of empty environment, devoid of perceptions and stimuli to act (von Uexküll 2010b: 51).

In *A Theory of Meaning* the tick case study is reread from a semiotic perspective, considering the perceptive and operative signs before any other environmental elements endowed with meaning; furthermore, the only slightly elaborated structure of the feeding functional circle of the insect makes it a simple counterpoint melody, which even the common reader can embrace with a glance. For these reasons, as well as for the choice of attributing even to an organism with an elementary environment the capacity to reperceive meaning, it is opportune to report the tick case study in its semiotic version.

Tick	Any mammal
Recipient of meaning	Carrier of meaning
POINTS	COUNTERPOINTS
1. The olfactory organ is set for only one smell, that of butyric acid.	1. The only smell common to all mammals is the butyric acid in their perspiration.
2. A tactile organ is present that secures the tick's exit from the hairs of its prey.	2. All mammals are hairy.
3. A temperature organ is present that lets a perceptive sign for the warmth sound.	3. All mammals have warm skin.
4. A stinger suited for boring through the skin of any mammal is present that also serves as a pump for liquid.	4. All mammals have soft skin well supplied with blood.

Common meaning rule: recognizing and attacking the prey, taking blood on the part of the tick.
(von Uexküll 2010b: 178)

In Uexküll's model, the feeding behavior of the tick is the alternating of points and counterpoints that is strictly regulated by the overall meaning of the relationship that exists between animal and environment. In the melody formed by this behavioral module, any extra notes – that is to say any other information or environmental element – would be inappropriate if not misleading; in other words, the tick is inaccessible to any kind of perceptual feature of mammals that is not provided for by the "common meaning rule" which organizes its feeding behavior. Here it is important to remember that Uexküll grants the term "rule" a constitutive and not merely descriptive meaning: rule for him is a real and causally effective factor that teleologically organizes the organic processes it is accountable for.[19]

The rigid organization of its relationship with the environment does not imply that the tick relates only with isolated features, which are not unified in an object; on the contrary, Uexküll states, "in its environment, there is a mammal that is composed of few properties but thoroughly clear [*anschaulich*]" (von Uexküll 2010b: 137). This "mammal-in-itself" (von Uexküll 2010b: 137), which is absent in human environments, is a kind of "primal image [*Urbild*]" (von Uexküll 2010b: 159) made from the features of the object that cannot be eliminated; this image is implicit in the counterpoint system represented by the feeding behavior of the animal. Although they are not reperceived – that is to say, it is not present as a whole on a perceptual or cognitive level – this image is the source of sense of the environment, which organizes itself around said behavior.

The notion of the primal image is further specified in one of the most original paragraphs of *A Theory of Meaning*, entitled "The interpretation of the spider's web". Starting from observations concerning certain structural features of the cobweb – mainly the diameter of its threads, which have to be resistant enough to hold a fly but thin enough not to be seen by it – Uexküll reaches the conclusion that the spider's web is none other than a faithful portrait of the "primal fly":

> It is indeed a refined picture of the fly which the spider produces in its web. But wait! The spider does not do that at all. It weaves its web before he has ever met a physical fly. The web can therefore not be a representation of a physical fly, but rather, it represents the *primal image* of the fly, which is physically not at all present (von Uexküll 2010b: 158–159).

In the relationship that a living organism has with another animal species, there is therefore the reflection of a part of the essence of that species – or, to use another of Uexküll's much-loved musical metaphors, there is a specific performance of its

[19] In *Theoretische Biologie* we find the concept of rule in the analysis of the controlled action ("first we have to know the animal's rule of action, and only afterwards can we approach the issue of the constitution of objects [in their environments]") and in the question of the formation of the embryo ("to the question: "How does a rule affect the protoplasm of the fertilized egg?" [. . .] our answer said it orders the series of impulses from the protoplasm" (von Uexküll 1928a: 134, 148; cf. also *above*, 115).

primal score (*Urpartitur*) (von Uexküll 2010b: 160).[20] Here we arrive at what is perhaps the heart of Uexküll's environmental biosemiotics: biological species are original texts and codes, atemporal and immaterial in themselves, which express a part of their meaning in every counterpoint relationship that they have with other texts and with the inanimate environment. In Uexküll's view, therefore, living nature is presented as an interweaving of meanings that extricate themselves in the weave of reciprocal relationships, and determine the same physical constitution of the organisms and their material creations:

> Surely, the spider's web is configured in a fly-like way [*fliegenhaft*], because the spider is also fly-like. To be fly-like means that the spider has taken up certain elements of the fly in its constitution: not from a particular fly but from the primal image of the fly. Better expressed, the fly-likeness of the spider means that it has taken up certain motifs of the fly melody in its bodily composition (von Uexküll 2010b: 190–191).

The living is a sort of "open symphony" with a modular composition. The individual performances (that is to say individual lives) are based on cores of predefined meaning – "the formative melodies" (writes Uexküll) "take their motifs from the formative melodies of other subjects which they will encounter on their life's stage" (von Uexküll 2010b: 198) – but the overall composition is not predictable beforehand.

Returning from musical metaphors to the semiotic perspective, nature appears as a system of signifiers (organisms in their physical appearance) that "read" other signifiers in order to shed light on their meaning, that is to say the original species-specific score. This meaning is not exhausted by any single "reading": the individual spider gives a specific performance of the fly's primal melody, which does not exhaust its expressive potential. As we have often shown, this process of reciprocal interpretation of meaning is not reperceived by the organisms that carry it out: the building-plans of living things are blind, and thus the process of performing the primal score of other living things is blind.[21] The primal subject, which is as much the author of the code as it is the founder of these specific interpretative relations, is and remains nature understood as a force endowed with intrinsic finality; in *A Theory of Meaning* nature is indeed qualified as "God-Nature" (von Uexküll 2010b: 192). On the basis of this connection (which is almost an equivalence) between natural processes and interpretative activity, Uexküll concludes *A Theory of Meaning* by stating: "As one can see, meaning appears everywhere as a decisive natural factor in always new and surprising forms" (von Uexküll 2010b: 205).

[20] Cf. also von Uexküll 2010b: 160, where the terms "primal image" (*Urbild*), "primal melody" (*Urmelodie*) and "primal score" (*Urpartitur*) are used as synonyms.

[21] As Giorgio Agamben observes in conclusion to his brief but accurate description of this Uexküllian passage, "though the spider can in no way see the Umwelt of the fly [...] the web expresses the paradoxical coincidence of this reciprocal blindness" (Agamben 2004: 42).

6.4 Dialogues on the Biological Vision of the World

The philosophical reflection on biology is an integral part of Uexküll's work over the course of his life. In his final years, this component acquired even more importance, as attested by the strong presence of texts designed to delineate the vision of the world which serves as the backdrop for his biological ideas, and often engages in a debate with other visions of the world. Uexküll chooses to carry out this heated debate in the form of a philosophical dialogue inspired by the Platonic model; but in these works Plato is also a point of reference from a perspective of content. The adoption of the literary genre of philosophical dialogue allows the author to "personify" the visions of the world which he deals with through emblematic and easily recognizable figures, thus conferring significant liveliness and immediacy to the theoretical dispute.

There are three main dialogical works by Uexküll: *Der unsterbliche Geist in der Natur* [*The Immortal Spirit of Nature*] (von Uexküll 1938, 1946, 1947), whose first part was published in 1938 and which is laid out as a series of dialogues between a philosopher of religion, a painter, a Darwinist zoologist and a biologist; *Das allmächtige Leben* [*The Omnipotent Life*] (von Uexküll 1950), a continuation of the 1938 dialogues published in 1950 by Gudrun and Thure von Uexküll using materials which were already in an advanced stage of preparation; and finally the brief work *Die ewige Frage. Biologische Variationen über einen platonischen Dialog* [*The Eternal Question. Biological Variations on a Platonic Dialogue*] (von Uexküll and von Uexküll 1943; edition used in this work von Uexküll and von Uexküll 1944).

6.4.1 The Logic of the Living Thing: Plato against Darwin

The themes dealt with in *Der unsterbliche Geist in der Natur* and in *Das allmächtige Leben*, despite the multitudes of developments and interweaving laid out by the structural narrative of the dialogue, can be divided into two main lines of argument. On one side, Uexküll attempts to specify his own vision of the world (an atheist but not materialist philosophy of nature) and to criticize its alternatives (from Darwinian biology to art and religion); on the other side, he decides to directly confront what is possibly the main philosophical problem arising from his *Umweltlehre*: the risk of closing subjects in isolated and incommunicable environments. In the following paragraphs, these two issues will be dealt with separately.

In the dialogues that make up *Der unsterbliche Geist in der Natur* Uexküll most clearly demonstrates his full awareness of the historical, sociological and cultural context into which his vision of the world falls. Through the character of a philosopher of religion, Uexküll explains western contemporary culture as the product of a secular process starting from polytheism and eventually achieved through modern, rationalist atheism. The aspect of this process that he mainly

underlines is not, however, the loss of the importance of religion in a theological or institutional sense, but rather the growing disenchantment of the relationships that man has with the world and nature:

> In the polytheistic structure of the world it is hard to see this correspondence to a plan, as the relational lines that connect all the operating world factors together seem to be entangled. In monotheistic structures, there are only passive factors and their relational lines are like a web where all the threads converge to the center. This center is both carrier and creator of the planned pattern (von Uexküll 1938: 14).

In polytheism, in other words, the role and responsibility of man would be heavily limited by the sacredness and autonomy of the natural world, which is situated on a plane of existence that is substantially equal with gods and demons. At the same time, however, though in a confused manner, man already participates in the sacred inasmuch as he is a natural being. Monotheism, instead, would concentrate all forms of the sacred in the single figure of God, so man, who now moves in a natural world that has become neutral from a religious point of view, is left only with the choice of whether to accept or refuse the place that God has reserved for him in the universal plane of history.

The next historical-cultural phase – whose defence is entrusted to the Darwinian zoologist, behind which we might catch a glimpse of Lorenz – is that of modern scientific atheism. Founded by the contributions of Bruno and Darwin, this phase would liberate man from his dependency on any sort of divinity and give him full power over his own life and nature in general. The biologist (who is easily recognizable as Uexküll himself) responds to the zoologist by shedding light on the negative aspects of modern material atheism, primarily the entrusting of the explanation of living nature to a mechanical principle such as Darwinian selection.

As we have seen, Uexküll's criticisms towards Darwin in his previous works are centered on the refusal of the idea (in fact more Lamarckian and Spencerian than Darwinian) that the environmental factors and the struggle for survival are what is directly responsible for the structure and behavior of living organisms; to Uexküll, this heavily prejudices the autonomy of living things and ultimately makes them indistinguishable from inanimate matter. In the dialogues of the years 1938–1943 (consistent with the stances expressed in *Theoretische Biologie*), though it remains substantially negative, Uexküll's behavior changes slightly: he admits that Darwin's theory is based on the idea of "long-lasting variability [*dauernde Variabilität*]" (von Uexküll 1928b: 20) of the organisms themselves, and so it at least implicitly recognizes the spontaneous activity of living things.

This admission, which may bring Uexküll closer to Darwin, is immediately neutralized by the observation that in Darwin's conception the variability of living thing is not guided by any kind of plan but is completely casual. Here Uexküll meets an insurmountable limit, because he believes that "true variations [. . .] are leaps in the vital direction of the species and always lead to a new purpose" (von Uexküll 1950: 60). In short, despite having abandoned the inflexible species fixism of his early years, Uexküll is unable to accept the idea that the becoming of species is contingent and not purposive.

The disenchanted and materialist vision of the world held by the zoologist is thus discredited in an indirect way, i.e. through an open and resolute attack on the Darwinian theory. Immediately after, taking advantage of the zoologist's objections that the idea of the contingency of evolution would at least allow for an escape from the ingenuousness of those who hold that nature had been created in the interest of man, Uexküll clarifies that his vision of the world – besides being clearly non-Darwinian – is neither Christian nor polytheist but rather a "fourth conception" (von Uexküll 1938: 23). His core belief consists in the full acceptance of the teleological character of nature; this aspect of nature is destined to remain unknowable inasmuch it will not be possible to state anything about the author of those plans. In Uexküll's *Weltanschauung*, nature, which is ultimately responsible for the universal harmony in the building-plans of organisms and for the interactions between organisms and environments, remains an "eternal mystery, which rests in action and acts while resting" (von Uexküll 1938: 24). We know its effects, and from these we can refuse the materialist version of the world with certainty, but – Kantianly – we cannot articulate their causes, which reside outside of our field of experience.

Let us move to the second line of argument carried out by Uexküll in his philosophical dialogues on biology. This was intended to refute the accusations of environmental solipsism which had been made against his theory. As Gudrun and Thure von Uexküll stated in their "preliminary observations" to *Das allmächtige Leben*, in the dialogues drafted in the last years of his life Uexküll tries mainly to respond to the following problem:

> In the theoretical organization of *Umweltlehre*, the question he [Jakob von Uexküll] viewed with major priority was that between the different subjective environments. The "counterpointistic" property of being-there-for-others displayed by living beings often coming from different species seemed to refer to over-subjective units, within which the environments of living beings from different species completed each other as co-belonging moments (von Uexküll 1950: 13).

This question is confronted directly in *Der unsterbliche Geist in der Natur*. In this dialogue, the attacks launched by the Darwinian zoologist, though they are often useful for the responses of Uexküll's spokesperson (i.e. the biologist), shed light on a real weakness in Uexküll's conception. The dependency of environments on the a priori structures of the subjects, one of the anchors of Uexküll's *Umweltlehre*, in fact seems to lead to those subjects' isolation within a closed species-specific "world". As the Darwinian zoologist points out with extreme clarity, if the environment (let us say of a mosquito) depends on the subject, then one can state that:

> "When the mosquito dies, so does its sun, and so does his when a human being passes. This means that all the world [*Welt*], or all the environment [Umwelt], as you prefer, is a product of the subject."
>
> "Certainly" – I answered [the biologist].
>
> "So" – the zoologist resumed triumphantly – "not only all objects, but also subjects are my subjective creation. And so I remain as unique subject and the ridiculous solipsism triumphs" (von Uexküll 1938: 47).

As we have often pointed out, this issue (highlighted by the zoologist) comes directly from the Kantian premises of Uexküll's theoretical biology, that is to say the idea that the constitution of reality – space, time, the forms of objects – is the result of an outward projection (*Hinausverlegung*) of nerve stimulations whose source is ultimately mysterious (as the Kantian thing in itself). We must not forget, however, that Uexküll's theory simultaneously foresees a counterpoint interaction among environments and different subjects, a reciprocal functionality that exceeds the perceptual and behavioral confines of single organisms. This certainly does not resolve the problem of the correspondence between species-specific environment and external reality, but it at least prevents the total closure of the subject in regards to the environments of other species.

In response to this question, in his philosophical dialogues Uexküll attempts to specify what he means by counterpoint interaction of environments; to do so he elaborates two new metaphors to be added to the images drawn from the world of music. The first metaphor, developed in *Der unsterbliche Geist in der Natur*, is based on the comparison between the variety of environments that make up nature and the multitude of images of a field that are reflected in the drops of dew in that same field:

> Each of these myriads of drops mirrors all the world with the sun, the mountains, the forests and the shrubs, a magical world within itself. Imagine for a moment, in his mind, that each one of these innumerable drops does not only shine in the diversity of the shimmering colors, but also possesses its own subjective tone, the one that distinguishes all living beings, then you will understand that the theory of the environment has nothing to do with the silly solipsism (von Uexküll 1938: 47–48).[22]

The solution that Uexküll proposes here is in many ways quite similar to the basic conception of Leibniz's monadology, in which the monads – the metaphysical subjects – each represent the concrete expression of a specific point of view on the world (Leibniz 1991: 85–89). And, just like Leibniz, Uexküll's believes the guarantee of agreement among the different images reflected in subjects resides in the pre-established harmony that is postulated among them; the biologist's response to the accusation of solipsism, in other words, serves to reaffirm the harmonizing function of a supersensible factor that Uexküll declares unknowable, but whose influence is well-visible.

With the second metaphor – which is present both in *Der unsterbliche Geist in der Natur* and in *Das allmächtige Leben*, and is inspired by Bilz's book *Pars pro toto*,[23] which profoundly influenced the late Uexküll– the life of an organism is seen as a series of theatrical scenes which come together to make up a whole.

[22]In the following pages the zoologist's vision of the world is defined "mono-world [*unimondal*]", and that of the biologist a "multi-world [*multimundal*]" one (von Uexküll 1938: 60).

[23]Rudolf Bilz (1898–1976). German psychiatrist and psychotherapist. After World War II he dedicated himself extensively to the study of human ethology, specifically instinctive behavioral reactions (shame, pain and fear) and their influence on the daily actions of man. For the work which Uexküll cites *cf.* Bilz 1940.

The environments of single individuals and, within them, single functional circles make up the "vital scenes"; actions are closely conformable to pre-established roles, and individual variations are not allowed except for man and, in rare cases, for higher animals. Therefore, with the passing of generations, "the roles of the play stay the same, it is the actors who change" (von Uexküll 1950: 55). Although it is not particularly original, the metaphor of the play allows Uexküll to establish an extremely close network of relations among the different actors – a network which determines even their physical structure: "since any role in any life scenario requires its counterpointistic counter-role, the animal's body is the reflection of its environment, which represents all the counter-roles" (von Uexküll 1950: 69).

In the end, even the second metaphor leaves the origin of agreement which exists among different roles unexplained: the question of who wrote this play, which is left hanging in a large part of the dialogues of *Das allmächtige Leben*, is brushed aside with the usual admission of unknowability (von Uexküll 1950: 67).[24] Yet, within the idea of life as a theatre script there is something new, which cannot be found in the image of the melody or of the drops of water that reflect the field; it consists in the irruption of a platonic tone in Uexküll's vision of the world. This tone, though present in the background of many of his works, until now had not been made clear.

All this emerges primarily on a lexical level. In *Das allmächtige Leben*, the sequence of individuals and the multitude of their concrete behavioral modalities is seen by Uexküll as a "world of appearance [*Scheinwelt*]" (von Uexküll 1938: 157) behind which primal and supersensible reality is concealed. This ultimate reality includes not only nature (as supreme subject) and the ideas of animal species, but also the archetypes of four fundamental functional circles, which Uexküll sees here as the roles that all animals are obliged to carry out: movement, escape from enemies, search for food, reproduction. In regards to this last point, we would cite one of the most significant passages in which we find not only a wide use of platonic terminology but Plato himself explicitly mentioned:

> The same four questions need to be asked about every living being in order to understand their role in the performance of life. In what element [does it move]? What does it feed on? Who are its enemies? Who are its sexual partners? These, in tune with Plato, are the four basic ideas of life. They appear in the environments of living being, with always renewed properties that match the various subjects' sense and effector organs. [. . .] The idea of media may translate as water, or air, or earth, but also as rain, snow, or sunshine. The idea of the enemy expresses itself in parasites and predators. The idea of food (or prey) is embodied by animals, plants, or salts present in the earth. The idea of the sexual partner is related to bodies which have an extremely close rapport with the subject of a certain environment (von Uexküll 1950: 158).

The ideas of the four fundamental roles – or, in the semiotic perspective which can be glimpsed in the background of the dialogues, of the four "primal meanings [*Urbedeutungen*]" (von Uexküll 1950: 157) – must be present in any animal

[24] In reference to the interchangeability of the actors who, in the human world, can play the same part in a given piece, Uexküll writes: "I have to admit the same is true for the dramas of life, whose author we don't know" (von Uexküll 1950: 67).

existence, and shape the physical reality of the organism as much as the diachronic articulation of their lives. As it was with Plato, many features of the relationship between the ideal and the corporeal remain obscure (so wonders the biologist: "How is the technical law that governs the building of the body of deadly actors affected by the scripted role, which is both immortal and immaterial?" (von Uexküll 1950: 74)); yet we must not forget that Uexküll mainly wants to shed light on the unifying value of the ideal structures which determine the vital scenes. The process with which the ideas-roles translate into sensible reality always involves (besides the subject) inanimate reality (the media in which the animal lives) and other animals:

> The technique of living nature works with roles as with fixed unities. But roles, even if they reach out to body and space, are not material units, rather *platonic ideas*, whose spiritual tissue serves as foundation to nature. In any case, the tissue of vital scenes, which are tied to each other through always renewed roles, goes well over the borders of single subjective worlds (von Uexküll 1950: 156).

The relevance given to primal roles attempts to resolve the problem of harmony among environments (or among vital scenes), whose realization must necessarily go beyond the representative and behavioral sphere of the single subject. With the fundamental ideas of life, in other words, Uexküll intends to correct the negative consequences of the Kantian transcendental position of his biological conception. Thanks to their unifying and harmonizing action, the solipsism of the living subjects and the isolation of the *Umwelten*, which are real and effective on the level of natural, sensible phenomena, prove to be illusory on the level of spiritual, primal and noumenal reality.

6.4.2 The Eternal Question: Biology and Personal Immortality

The choice of the dialogue as literary genre and the clear presence of platonic features also characterize *Die ewige Frage*. Written together with his son Thure, this brief work consists in a free rewriting of the platonic dialogue *Meno*, into which the two authors interweave their original reflections on the basic theme of personal immortality. These reflections are openly led with a biological perspective, but it is important to remember that when the authors speak of biology they mean the conception that Jakob von Uexküll has developed in the course of his life, including also its philosophical aspects. In short, as Uexküll states in the opening of this work, *Die ewige Frage* was written with the intention

> to connect the evidence in favor of personal immortality as long as they are biologically significant, which we can achieve at best if we refer to the platonic dialog that has yet supplied the most convincing evidence [*Meno*] and if we compare it with our biological knowledge (von Uexküll and von Uexküll 1944: 10).

Before analyzing the way in which Jakob and Thure von Uexküll interact with the platonic text, we shall summarize the content of *Meno*. This work consists in an inquiry on virtue that Socrates conducts over the course of his dialogue with young

Meno. Following the indirect and ironic strategy which he regularly employed, Socrates declares that he does not know what virtue is; in this way he attempts to make his interlocutor expose himself by formulating a hurried and easily refutable hypothesis. Contrary to many of Socrates' interlocutors, Meno does not fall into this trap and instead counterattacks; he asks how Socrates can declare that he is searching for something of which he knows absolutely nothing. Meno's accusation takes up the sophist argument for which it is impossible for man to search for what he knows as well as for what he does not: impossible for what he knows because he already possesses it and no longer needs to search for it, and for what he does not know because he would not even know what to search for.

Socrates' articulate response references the theory of metempsychosis, which was widespread in the mystery religions of antiquity and often cited by Greek philosophers. According to this theory, the soul of man is immortal and would be reborn in a new body after the death of the old. Socrates holds that since nature never changes, every soul has thus already seen everything there is for it to know, both in this world as well as in Hades. Yet, upon every new reincarnation the soul forgets the knowledge it has acquired, which can, however, be made to return through the teaching of philosophers and wise men. To demonstrate what he has stated, Socrates asked Meno to call a young slave and put him to the test. After having drawn a square in the sand, using the appropriate questions Socrates leads the slave to demonstrate the Pythagorean Theorem, thus drawing the conclusion that the young slave already possessed the necessary geometric knowledge and only needed for someone to stimulate him into remembering. In Plato's intentions, the experiment conducted with the slave aims not only to demonstrate that it is possible to search for what one does not know, but also to provide a philosophical proof of the immortality of the soul which can be integrated with the mystery-religious theory of metempsychosis. In short, the fact that a slave who clearly would not have had education found such complex knowledge in his own soul is taken for an empirical proof of the immortality of the soul.

From this point, without abandoning the narrative expedient of the dialogue between Socrates and Meno, the two authors of *Die ewige Frage* diverge from the original text and begin to analyze the platonic proof of the immortality of the soul starting from their own biological categories. This original revision of the platonic dialogue is divided into two parts, the first by Jakob and the second by Thure. Although, as pointed out, father and son fundamentally agree, the presence of significant differences renders it opportune to treat the two parts separately.

The departure point of Jakob's section consists in Socrates' invitation to Meno to consider whether animals too possess knowledge or skills without having had the possibility to learn them from individual past experience, which therefore seem to come from past lives. The examples made by Meno are what ethology defines innate or instinctive behavioral sequences: a sparrow's ability to build a nest by using the materials typical of its species and carrying out rigidly codified movements, or that of a nightingale to perform species-specific melodies even when the opportunity for imitative learning is absent. For this type of action, which is common in the animal kingdom, Jakob clearly refuses to use the term instinct. This term, as the

dialogue shows, is nothing more than an empty concept ("Socrates: "Is it not to that knowledge, which stems from another life, that the word 'instinct' refers to?". Meno: "Yes, that is so, Socrates" (von Uexküll and von Uexküll 1944: 35)). Socrates continues by suggesting that instead of instinct it would be preferable to use terms such as "rule" or "role", which more adequately express the ability of individual animals to follow the typical behavioral norms of their species.

Here Meno objects that, if thought of in this manner, the relationship between animals and rules would become analogous to the blind obedience to natural laws which characterizes inanimate matter, and the behavioral modalities of animals would be indistinguishable from the process which changes a drop of water into ice. Socrates answers by laying out an articulate theory in which the modalities of relation to the rules of material elements, plants, inferior and superior animals and finally man accurately differ from one another.

Inanimate elements are, so to speak, condemned to the repetition of physical processes which they do not perceive or "know of" in any way:

> Socrates: "Water and ice immediately obey the role that Zeus implanted in them, but they know nothing of one another and nothing of the world outside them, because they possess no organ for the perception [of the environment], and so no knowledge either. Yet, they are both, as role carriers established by Zeus, immortal and appear when the occasion calls for them" (von Uexküll and von Uexküll 1944: 38).[25]

Socrates continues by asserting that neither plants nor inferior animals can be attributed with true knowledge; even if they are living organisms, they, too, are limited to "a mere repetition of a role" which nature has assigned to them. With superior animals – what Socrates and Meno call "big animals" (out of respect for the plausibility of the dialogue they cannot use a modern scientific language) – the situation is more complex: if on one hand there are innate abilities and knowledge which come directly from the rules of the species ("knowledge around their [own] role and around the meaning of their own action"), on the other there is also knowledge that cannot be traced back to role, nuclei of experience born not from the repetition of the essence of the species but from processes of individual learning (von Uexküll and von Uexküll 1944: 39). If they become less frequent in superior animals, in man the behavior based on the mere repetition of role disappears entirely:

> Meno: "Such actions are practically unheard of in human life. Men always turn towards models taken from this life. They have no hidden knowledge coming from a past existence that they could use as a rule for their current actions. Yes, it was even difficult to prove that my slave possessed such knowledge, sinking into oblivion, which only the skill of your questions succeeded in bringing to light" (von Uexküll and von Uexküll 1944: 40).

As we can note from the cautious critique with which Meno casts doubt on the validity of the slave experiment, Socrates' classification of the behavioral

[25] As Uexküll points out in the introduction to *Die ewige Frage*, for the Greeks the gods are a sort of narrative fiction with which to portray different aspects of nature (von Uexküll and von Uexküll 1944: 17).

typologies corresponding to various levels of the living brings with it a very relevant consequence. The distinction between behavioral modalities determined by the repetition of role (those of lower animals) and behavioral modalities which are a result of individual knowledge (those present in higher animals and paradigmatically in man) brings Uexküll to subvert the platonic beliefs that human knowledge is reminiscence; but, since in the original *Meno* the immortality of the soul was based on this very element, then human beings and their knowledge prove to be more transitory and ephemeral than the remaining animal kingdom.

Furthermore, Jakob emphasizes (through Socrates) that in terms of the security that animals draw from the repetition of their role in nature, man seems at a great disadvantage, condemned to spend a great deal of effort in conquering the rules of his own action. Upon investigation, however, the inability of man to act with the security with which a bird builds its nest is also the condition for much more plastic and varied action: "Imagine if our Praxiteles had in his memory only one model for all the images of gods" – Uexküll writes – "would he be able to please our eyes and our heart with new and splendid work?" (von Uexküll and von Uexküll 1944: 41). At the end of his part of the dialogue, Jakob summarizes the internal relationships of living things in the following terms: plants, animals, and man all participate in the wisdom of nature, but while plants and animals are limited to repeating it (plants unwittingly and animals with different degrees of awareness), man must find it (or recreate it) from his own individual experience and (as the example of Praxiteles points out) from the cultural tradition he is born into. For this reason, the action of man is exposed to greater insecurity (individual experience can be brief, cultural conditions uncertain or even deceptive), but it also allows for greater plasticity and variety of means and outcomes.

Although it maintains an overall resemblance to Jakob's ideas, the part written by his son presents (as mentioned above) certain significant peculiarities (for this figure and Thure von Uexküll's work cf. *above*, 30, n. 24). In contrast to Jakob's, Thure's terminology reveals a deeper understanding of contemporary zoology and ethology – for example, the question of the "knowing" of animals is outlined as "the problem of heredity of acquired characteristics" (von Uexküll and von Uexküll 1944: 50). Furthermore, his theoretical approach seems clearly influenced by the German philosophical anthropology of the twentieth century, Scheler in particular; the status of man is thus qualified as a "special position [*Sonderstellung*]" (von Uexküll and von Uexküll 1944: 53, 58) in the heart of nature, and his duty is to "reawaken nature with the spirit's awareness" (von Uexküll and von Uexküll 1944: 60).

Thure bends his father's theoretical biology in order to state (following Scheler) that man is a being of dual nature: if on one side, as in all other animals, he is the result of nature's shape-creating power, on the other, however, through awareness and spirit the human being can make himself autonomous from nature itself, and simultaneously trigger an increase of the ontological level of nature. The question of the duality of man also appears when Thure gives his response to the "eternal question" which is the basis topic in the *Meno*: the question of personal immortality. It is clear that, after having relativized the Socratic experiment with the slave, the two authors of the "biological variations" on the platonic dialogue cannot go back

and affirm personal immortality basing it on the theory of metempsychosis. But, and this is even more relevant, they cannot even anchor it to species-specific roles and rules, because both Jakob's conception of the cognitive and behavioral insecurity of man and Thure's emphasis on its *Sonderstellung* inexorably distance it from the world of blind repetition of the organic ideal which, in conclusion, is the only form of immortality allowed for in *Die ewige Frage*.

Therefore, the conclusion to this dialogue (entrusted to Thure) is as follows:

Socrates: "And how do you think the dual nature of man affects our problem?"

Meno: "As man originates from two different kingdoms, Socrates, I should think that it will appear in his final days, whether he will dissolve into the dark abyss of natural being, following the general heaviness of his nature, or whether the divine fire blazed through him so much as to make him light and bright enough for a higher existence in the spiritual element."

Socrates: "And how do you picture such an existence, Meno? Do you believe the soul of man will be so to speak split into two pieces, one earthly and one spiritual, which now separate and that each one goes back to its own kingdom?"

Meno: "No, I do not believe so. However, I think that nature itself, where it was penetrated by the blaze of the spirit, reaches a higher being. [...] So every one [of man's] word, every glance, every action is laden with responsibility for what takes shape in front of our eyes, as a mirror of ourselves, in which the divine fire can glow or the dark primitive being of nature can hold its ground. In this case, man has missed his existence and there remains only what would have existed without him" (von Uexküll and von Uexküll 1944: 61).

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Chapter 7
Influences and Interpretations of the Work of Uexküll

Abstract The chapter present a reasoned overview of the influences that Uexküll exercised on later philosophers and scientists and of the main lines of interpretation which have been followed for his work. Of particular importance are, among others, the interpretation of Scheler that the constitution of the environment would be a kind of perceptual selection of the most relevant traits of the external reality; the interpretation proposed by Heidegger, in which the Umwelt encloses the animal in a sort of tunnel made of stimuli; the criticism of Lorenz to the vitalism and (potential) solipsism of Uexküll's environmental theory; Sebeok's biosemiotic interpretation, which attests the validity of Uexküll's transcendental-semiotic approach and opens new ways towards an information ecology.

Keywords German philosophical anthropology • Continental philosophy • Ethology • Biosemiotics • Interpretation of the Umwelt theory

To come to a complete picture of the influences that Uexküll's work has had on later philosophical and scientific thought is not an easy job. Even though he did not leave behind an actual school, echoes of the environmental conception of the Estonian biologist are found more or less directly in authors who are very different from each other; naturally, they highlight and use aspects that are extremely different. To mention two examples that might contrast the most, references to Uexküll are often found in Konrad Lorenz's ethology and epistemological reflections as well as in the distinction that Heidegger draws between man and animal based on the relationship that the two types of beings establish with the world. Therefore, without making claims of completeness, the following chapter aims to highlight the most significant influences that were exercised by Uexküllian theoretical biology on various schools of thought from the twentieth century and in our contemporary age.

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7.1 Uexküll in Twentieth-Century German Philosophical Anthropology

The philosophical branch where Uexküll's influence is the strongest could be German philosophical anthropology of the twentieth century. This applies to the three principal thinkers of the branch (e.g. Scheler, Plessner and Gehlen) as well as two philosophers (Cassirer and Susanne Langer) who can be associated with the subject matter and interests of philosophical anthropology, at least indirectly. In order to find a common thread to philosophical anthropology, firstly its intent should be pointed out to reunify the image of man in a sociocultural situation, the early 1900s, where it appears extremely fragmented. In particular, philosophical anthropology tries to restore man's unity on two specific fronts: on the one hand it wants to reconstruct the dichotomy between mind and body, or between physical and psychic, specifically from the Cartesian and later Kantian legacy (without going back any further). On the other hand it wants to overcome the state of schism that reigns between the various modern and contemporary disciplines that deal with human beings, from traditional philosophy to psychoanalysis, from ethnology to sociology and from history to cultural anthropology.

The line taken by philosophical anthropology in this reunification work is not based (and herein lies its productiveness) on the identification of a hegemonic and privileged ontological element in mankind, to which is assigned an elevated capacity of unifying the sphere of experience – such as the spirit in the Platonic-Christian tradition, or the Cartesian or Kantian "I think", or even the Hegelian spirit – but on the definition of a coherent relationship with the life and action context of man. In philosophical anthropology, the notion delegated to this task is man's special collocation (*Sonderstellung*), a notion that is stated by the above-mentioned authors in different ways but functionally alike: the specificity of man is traced in the qualitative difference that his relationship with the life sphere presents compared to the relational modality that characterizes the living beings in general (for example, in Plessner and Langer) or animals in particular (as in Scheler and Gehlen). Here we locate Uexküll's contribution: the biologist provides to philosophical anthropology not only the concept of Umwelt, which easily applies to indicating the operative context of a living being, but also valid comparative instruments to think about the relationship between animal and environment and between man and world.

As we will see, this does not mean that the Uexküllian concept is integrated without any modifications in philosophical anthropology. Many elements make this impossible: first of all, the intent of Uexküll's *Umweltlehre* to show that there are not qualitative steps between the environments of higher animals and that of man but only, so to speak, combinatory differences in the use of higher environmental elements. If this is true, however, it is also true that exactly the limits of Uexküll's "gradualist" position can suggest valid strategies for philosophical anthropology to define, even against him, the fundamental traits of man's *Sonderstellung.*

7.1.1 Scheler

In the philosophical panorama of the twentieth century, the first to recognize Uexküll's work and its possible implications even outside of biology is the philosopher of phenomenological formation Max Scheler (1874–1928), who already includes significant references to Uexküll in his work from the 1910s. In particular, Scheler refers to Uexküll's first edition of *Umwelt und Innenwelt der Tiere* and *Bausteine zu einer biologischen Weltanschauung* in *Ressentiment* (Scheler 1988) and in the positive review of *Bausteine zu einer biologischen Weltanschauung* which appears in 1914 in the magazine "Die Weißen Blätter" (Scheler 1914; edition used in Scheler 1993: 395–397); finally Uexküll's influence is clearly seen (as well as proven by direct citations) in the theory of the environment-world presented in *Formalism in Ethics and Non-Formal Ethics of Values*, written by Scheler between 1913 and 1916 (Scheler 1973).

In general, Scheler outlines how the work of Uexküll is well-placed in a trend of criticism on evolutionary and Darwinian mechanistic biology and its materialistic and reductionistic vision of the world. In *Ressentiment*, with touches that recall the indignation of Nietzsche, Scheler condemns the autonomy loss of the living and the "neutralization" of its intrinsic value caused by the growing assertion of the scientific mentality of the Western man; as such, Uexküll is seen as a precious ally in the work of unmasking the effects of resentment in the formation of the modern vision of the world. In short, it is identifiable in the systematic substitution of life-related values by profit values that are typical of the capitalistic middle-class mentality (see Scheler 1988).

In particular, according to Scheler, the Estonian biologist's work would allow a refutation of the erroneous yet widespread interpretation of an organ as a mechanical instrument and an organism as the sum of its mechanical parts. Scheler outlines how it is necessary in biology to avoid "hypostatizing the environment [*Umgebung*] of man and wrongly make it the world in itself" (Scheler 1993: 395) and "explain vital phenomena by applying concepts and forms of perception that are proper to an "intellect" which has itself originated as *an instrument* of the specifically *human* vital activity and is completely dependent on its tendencies" (Scheler 1988: 140). It is in view of these errors – shared by Darwin and Spencer, that Scheler accuses of having a "philistine anthropomorphizing perspective" (Scheler 1993: 395) as well as by animal psychology – that the biological context of living being can be seen as an arid material world (basically analogous to that of Western man) where the organism cannot do anything except adapt mechanically.

In the review of *Bausteine zu einer biologischen Weltanschauung*, the most direct of the texts mentioned, Scheler states that Uexküll would be successful in avoiding this mistake by firstly distinguishing between "the "environment" which objectively acts" on the animal and "the perceptive world provided to the animal" (Scheler 1993: 395). This distinction, other than radically rebutting the idea (problematic on the whole, even in the case of human beings) that everything that acts on an organism is also felt by it, allows us to specifically consider different environments,

evaluating case by case for how much is perceivably given to the animal subject and how much is instead part of the unfelt operative world. Starting from this distinction, which faithfully mirrors Uexküll's thinking, in the review of *Bausteine zu einer biologischen Weltanschauung* Scheler concentrates almost exclusively on the felt part of the environment, i.e. on the species-specific perceptive worlds. This choice – probably due to his phenomenological training and to the fact that he is mostly interested in human environment (an environment that, according to Uexküll, has a larger number of reperceived elements) – begins a line of interpretation that will be constant in Scheler's reading of Uexküll's work.

That interpretive line is centered on the idea that the environment is essentially the result of a perceptive selection made by the subject. According to Scheler, for example, the animal that is intent on the perception of the environment "takes out only some elements from the universe as a whole and makes its environment" (Scheler 1993: 395); in a case study reported by Scheler himself, the starfish is given to the sea urchin "as something characterized by a certain size and a certain motion", while the same object for a man "is also defined by shape and color units, but lacks in olfactory quality" (Scheler 1993: 395). In other words, in Scheler's reading, the environment of animals appears from the beginning as a "collection" of perceptive features based on sensorial capability. Some species take on multiple environmental qualities while others take on fewer, but it is undeniable that environmental traits are objectively present in the external reality (and not constituted by the transcendental subject).

This line of interpretation is confirmed and expounded upon in *Formalism in Ethics and Non-Formal Ethics of Values.* Even before Uexküll's name specifically appears in the text – which only happens once, in a note in which Scheler reaffirms the value of the biologist as a critic of the anthropomorphism of the Darwinian and Spencerian vision of the world (Scheler 1973: 155–156, n. 46) – in any case the analysis of the "practical milieu" of man conducted in this text lets the influence of Uexküll shine through. This is clearly perceptible as much in the general tone of the analysis as in the terminology and examples chosen by Scheler:

> One point must be clarified at the beginning. The "things" of our deeds and acting [...] have nothing to do with Kant's 'thing in itself' or with scientific objects [...] The sun of the milieu [Umwelt] of human beings is not the sun of astronomy. Neither stolen meat nor bought meat is a sum of cells and tissues and their chemicophysical processes. [...] Such *milieu-things* [*Umweltdinge*] as objects of action are *value-units* and *real things* (Scheler 1973: 139).[1]

The line of interpretation of which we have shown the main features above is also well reiterated in *Formalism in Ethics and Non-Formal Ethics of Values*.

[1]The italicization of the expression "milieu-things", by which the typically Uexküllian term *Umweltdinge* is translated (for example, see *Theoretische Biologie II*, 132), is from Scheler; the same is true for the other italicizations. The text also presents Uexküll's example of the different experiences that different subjects have of the same object (woods for the gamekeeper, hunter, hiker, steinbock and lizard) (see Scheler 1973: 143).

Firstly, the Uexküllian environment intended by Scheler again privileges the lived aspect over the operative one: "*only what one effectively experiences belongs to one's milieu* [*Umwelt*] [,] [. . .] only what I experience as 'effective' on me" (Scheler 1973: 139; italics by Scheler). Scheler correctly points out that this does not mean that we have a clear perception (let alone a symbolic representation) of all the elements and environmental processes; nevertheless and contrary to Uexküll, at least for man, Scheler does not foresee the existence in the environment of operative marks that are able to provide "connections" to the organism's action without being phenomenologically present to the subject in any way. In conclusion, Scheler's environment is the phenomenological "reservoir" from which perceived contents can be taken: "the milieu [Umwelt] is *not* the sum of all that we sensibly perceive; rather, we can only sensibly perceive *what belongs to the milieu"* (Scheler 1973: 148; italics by Scheler).[2]

Secondly, the key idea of the selection from an external reality also returns in the Schelerian analysis of mankind's ethical world. Moreover, in *Formalism in Ethics and Non-Formal Ethics of Values*, a text designed to rebut the formalism of Kantian ethics through the analysis of the essence of value, the concept of Umwelt (whose English translation by M. Frings and R. L. Funk is expressed with "milieu") assumes particular importance. According to Scheler, the objects that the moral subject encounters in his experience are not, like for Kant, mere sensitive beings that determine it from a physical point of view (which moves the moral realization onto the level of pure willingness and intention). They are instead empowered by an original "*feeling* of the (positive or negative) *value"* which makes them "*possible objects for the realization of complexes of values"* (Scheler 1973: 134). As Guido Cusinato shows, it is a matter of a peculiar perceptive modality, with man as the personal center, which allows for the understanding and interpretation of those phenomena, such as blushing and erotic compatibility, which are linked to a "*corporeal expressivity of the over-sensitive type but mundane"* (Scheler 2009b: 48).

While implicating this type of over-sensitive excess, Scheler says that the personal subject and the world ""fit" one another" in a way that closely resembles the relationships that exist between an animal and the Uexküllian Umwelt; "the value-complexes of pure willing (or of its value-projects), even though they contain only the *same* value-qualities (and their order) as the value-complex of the "practical world", are not "derived" from the practical world" (Scheler 1973: 134; italics by Scheler). In conclusion, practical objects "*are selected according to and on the basis*

[2] Also found in *The Human Place in the Cosmos,* where Uexküll however is not directly quoted, the selective correlation between animal and environment is explicitly attributed to the physiological and driving state of the organism: "The departure from psycho-physical actions and reactions is the first act of the drama of *animal behavior* with regard to its environment. The structure of the environment fits exactly to, and is "fixated" in, the physiological peculiarity of an animal and indirectly to its morphological structure, and so its environment also fits the firm function of its unity of drive and sense structure. Everything which the animal notices and grasps in its environment is securely embedded in the frame and *boundary of its environment*" (Scheler 2009a: 27–28; italics by Scheler).

of those *values* which permeate the *moral tenor* of this willing [the willing of the moral subject]" (Scheler 1973: 134; italics by Scheler). Therefore, according to what has been said to this point, at least for the case of man, it emerges in Scheler's opinion that the selection from external reality that makes for an environment-world depends neither on mere perception, nor on the life interests of the subject or on his representative ability. Instead the selection of the environment is placed on the level of the *Leib,* of an experience lived simultaneously on a bodily and personal level – or rather on that level of feeling where the contents of the external realities are immediately and intuitively efficacious on the real subject: "the milieu that we experience is always *wider* and *fuller* and given as more efficacious on us than what we apprehend and perceive" (Scheler 1973: 150; italics by Scheler).[3]

On the basis of these two cornerstones of Scheler's reading of Uexküll – the phenomenological privileging of the felt environment and the idea of the environment as the result of a selection from an external reality – it is possible to make a critical observation. Even though he complains about the lack of close philosophical examination by Uexküll (what happens in several points in the review of *Bausteine zu einer biologischen Weltanschauung*), Scheler does not consider the references that the Estonian biologist makes to Kant, and that have the clear intent to base theoretical biology on the transcendental conception of the philosopher of Königsberg. In particular, Scheler does not consider the fact that by adhering to Kantian philosophy Uexküll affirms that the subject does not limit itself to selecting the aspects of an external reality. Rather, it actively forms the objects of the environment and the coordinates in which they are placed. If it is true that this mostly emerges in works by Uexküll, such as *Theoretische Biologie* and *A Foray into the Worlds of Animals and Humans*, that come after the period under consideration, it is also true that the connections to Kantian philosophy are also obvious even in the works that were available to Scheler (see for example von Uexküll 1913: 151).

However, this does not mean that the Kantian coordinates of the problem completely escape Scheler. In the above quote, he states that the environmental objects do not coincide with the Kantian thing in itself (which Uexküll would agree with), while avoiding drawing the conclusion that Uexküll makes – that they are the product of the activity of the transcendental subject that is theologically guided by an immaterial force. This would have led Scheler in a direction that he did not want to take: to attribute to the conscience an activity that is not only selective but also constitutive of worlds (better yet, environment-worlds). As often seen, this theory brings up the problem of the closing of the environments, which is inevitable if

[3] As Cusinato states, Scheler understood well that in Uexküllian biology, "*Leib* is at one with Umwelt, just like the spider is at one with the web it weaves, so much so that the structure of the Umwelt is defined according to the way the organism's structure is and vice versa" (Cusinato 2008: 180). This understanding, even if it highlights one of the most shared and fascinating Uexküllian thoughts, must be instead coupled with a serious confrontation with the intrinsic limits to the environmental theory of the Estonian biologist – in particular, with the fact that the environment is the product, according to Uexküll, more than the phenomenological *Leib,* or the teleologically structured *Körper* in biology and vitalist physiology.

Uexküll's theoretical coordinates are completely adopted. In fact, it is one thing to think about environments as diverse selections of elements from a single objective reality; it is another to think of them as spontaneous transcendental structures that are produced by subjects, animals and humans, beginning with signs of unknown origin (the peculiar semiotic construction of the Umwelt that we have discussed above).

In conclusion, if on one hand Scheler finds Uexküll to be a precious ally in the fight against the "anthropomorphous assumptions of the evolutionary theory, according to which there is one single environment shared by all living beings, one single setting for a struggle for an existence based on the human model" (Cusinato 2008: 180), and draws from his work valid indications about the existence of different perceptive worlds and of a very close relationship between body, environment and experience, on the other hand he expresses quite a different intent from Uexküll: to avoid having even humans find themselves closed inside their environment, as happens with animals. As Cusinato points out when talking about the Schelerian notion of *Weltoffenheit* and the fundamental connections that it has with the erotic dimension of human beings, "what Uexküll's mosquito is missing, stuck as it is in environmental poverty, is precisely the erotic perspective: a perspective which postpones satisfaction, creates a distance and makes it possible to notice an object that would usually, due to the blindness of instinct, stay hidden behind the set of the environmental marks" (Cusinato 2008: 198).

The diversity of intents between Scheler and Uexküll set us in front of the first example of what we preliminarily defined as the common interpretive strategy of the masters of classic German philosophical anthropology in relation to the work of Uexküll: an anti-mechanical and anti-reductionistic use of the Uexküllian concept of environment, but placed alongside the willingness (not part of the intentions of the Estonian biologist) to determine through that concept the qualitative difference of man compared to animal. Reserving ourselves the possibility to take up this point again later on, we also note that another element of incompatibility between philosophical anthropology and Uexküll is evident in the clear adhesion of this latter to Kantian transcendental philosophy – a point that actually cannot be reconciled with the anti-intellectualism of the former and its determination not to reduce the world to the product of the synthetic and constitutive activity by the transcendental subject, whether human or animal.

7.1.2 Plessner

Between 1910 and 1913, just before his phenomenological turning-point related to attending Husserl's lessons in Göttingen, Helmuth Plessner studies zoology in Heidelberg under the direction of Hans Driesch. During this period, he is able to meet Uexküll in person and then later on he continues to carefully read Uexküll's work (most importantly the second edition of *Umwelt und Innenwelt der Tiere*). Therefore it is not surprising that in the foreword to the first edition of *Die Stufen*

des Organischen und der Mensch [*Levels of Organic Being and Man*], Uexküll (together with Driesch) appears as the creator of a "new biology" that can easily be integrated in the philosophical-anthropological research project that reclaims the unity of man and the recognition of his relationships with non-human living beings (Plessner 1975: III).

Like Scheler, Plessner also takes the opportunity to use Uexküll's work in a critical way, i.e. to unveil the naïve anthropomorphism both of evolutionistic and behavioristic mechanism and of the (almost completely discredited at his time) animal psychology: "it was thanks to Uexküll and to new research on behavior" – writes Plessner – "that we got rid of anthropomorphous analogies" (Plessner 1975: XIV).[4] Also and above all, though, Plessner uses the Uexküllian theoretical biology on a positive note: firstly in the definition of the living being as a unit which is organized teleologically, and secondly in the clarification of that particular living form which is the animal. We will examine these two points separately.

Even though it is in a subordinate position compared to his own original concepts – such as positionality (*Positionalität*) that we will briefly show thereinafter – Plessner uses the traditional characterization of the organism in order to define the living being as an organized unit. Here lies the first reference to the Estonian biologist:

> "organization", as Uexküll himself put it, refers to the union of elements of a different nature, following a unitary plan for action in common. [...] Organization is the way to be there of a living body, which needs to distinguish itself; through and with this differentiation it gives *rise* to the inner teleology *according* to which it shows itself as functioning and endowed with a shape (Plessner 1975: 169–70; italics by Plessner).

Nonetheless, it is significant that Plessner feels the need to immediately clear the field from any possible misunderstanding linked to the use of the Uexküllian (and Drieschian) concept of organization, which means the idea that the organization of the living body refers to an organizing force that is separate from it and from matter in general. According to Plessner, who thanks to the linked influences of Max Weber and of phenomenology tries to maintain even the research of the essential character of the living on an idealtypic level,

> it is not so that the unitary plan is *realiter* present at first and is then followed by the union of the elements, but rather that diversity and unitariness become real at the exact same time. [...] This view should allow to keep clear from effective ideas that transcend matter and

[4]Plessner references the article that Uexküll writes together with Bethe and Beer in 1899 with the intent of introducing to physiology an "objective terminology" that will substitute expressions such as sight and hearing with more neutral terms (see *above*, 28); however, he distances himself from this program (motivated by the hostility toward animal psychology) and accepts "at least the scientific justification of terms like see, hear, feel, smell, etc. referred to animals" (Plessner 1975: 67). For the rest, Uexküll himself does not comply with the programmatic indications, which are often extreme, contained in this article, which would probably have made impossible the elaboration of his theoretical biology (simply think about the risk of anthropomorphism contained within the word "meaning", which is given considerable importance in the last phase of the Uexküllian thinking).

> from God's building ability to explain the wonderful conformity to purpose and harmonies which organisms display. [...] The animated living thing itself brings about the order-creating conditions (Plessner 1975: 170; italics by Plessner).

Therefore, as far as the definition of the living form of the animal is concerned, the use of Uexküllian categories – a wide use full of precise references – is placed within a more complex theoretical context, i.e., in a manner of speaking, in the main structures of Plessnerian philosophy. We are reminded that the essential difference in Plessner between the living and the inorganic is found in the concept of *positionality*: if the inanimate body is a mere extension (it has a beginning and an end in space), the organic body is positional. It borders the outside through a limit (*Grenze*) which has a double function: it defines and relates at the same time. For this reason, the living is constitutively characterized by the duplicity between an inner and an outer sphere. Depending on the organizing level (plant, animal, man) where a certain living being is located, not only the typology of the limit, but also the relationship that the organism has with the limit itself varies. If it can be said in any case that the limit *belongs* to the living being (while it does not belong to the inanimate body), the modality of this belonging, and therefore also the way in which it relates with the exterior reality, changes for the different realms of the organic (see Tolone 2000: 90–112).

In light of this, plants represent open forms, that is, organisms that are immediately inserted within the surrounding context; this makes them non-autonomous parts of their own life cycle. This is demonstrated since they are connected to a place and, moreover, they lack internal organs structured around a center. Basically, the open form of plants comes from the fact that the limit, even though it is present, is not able in their case to establish itself as a mediator with the surrounding context: between the action of the physical context and the plant's reaction, there is neither a solution of continuity nor any pause for (sensorial or motor) processing. Instead, this does happen in the closed form of the animal. In this case, the active presence of a limit is able to place the organism in the environment in a mediate manner, and this makes the animal an autonomous component of its own living cycle. This corresponds to the formation of differentiated (motor and sensorial) organs, to the structuring around organizing centers, and (in higher animals) even to the creation of a central representative organ that can mediate between the sensorial and the motor sphere and between stimuli and reactions.

It is in the definition of the closed form that the influence of Uexküll, specifically of the second edition of *Umwelt und Innenwelt der Tiere,* decisively appears. In the sixth chapter of *Die Stufen des Organischen und der Mensch,* dedicated to the sphere of animality, there are numerous and precise references to Uexküll. They span from paying a theoretical tribute ("The sensorimotor schema, the "functional circle", as Uexküll says, is the condition for the possibility of the closed shape's reality, for the idea of animal organization" (Plessner 1975: 230)), to integrating into the description of the closed form specific elements of the Uexküllian theoretical

biology: the multiplicity of the species-specific environments (Plessner 1975: 247),[5] the distinction between perceptive and operative sphere (with the statement of the typically Uexküllian principle that the presence of an organizing center in higher animals leads to an increase of the perceptive sphere's extension (see Plessner 1975: 248)), and finally the distinction between the "poor" environment of lower animals ("field of pure instantaneity, filled with signals that flare up and disappear again, the effectiveness of which depends on impulses and their fulfilment") and the more stable and well-structured one of higher animals ("field of concrete reality [. . .], of moves and steps to carry out and avoid, [made up of] persisting and awaiting facts" (Plessner 1975: 252–253)).

It is on this last point – the articulation of higher environments – that Plessner demonstrates that he reached a deeper understanding of Uexküll's environmental theory than Scheler did. The articulation of the perceptive environment of a closed form is actually not the result of only the selection of environmental elements that already exist; the nervous system of higher animals actively organizes the perceptive elements in thing-like, persistent constructions that appear to the subject as given units, but in reality are the result of an activity of synthesizing and processing information:

> The unity of an evident thing is based on a structure's optical, acoustic, tactile contents, which enter in one another and cover one another without hiding each other; on the contrary, they openly show how the thing reveals and manifests itself, while they do leave a hidden rest, the "core", as the carrier of the properties. How would this be possible without a particular schema? (Plessner 1975: 253).

Most importantly, it is the final mentioning of the schema to send us back to the beginning of the Plessnerian theory of the creation of higher order environments, a beginning that is not only Uexküllian but also Kantian. Plessner recognizes not only that the higher animal's environment "contains "things next to each other, one after the other"" but also that Uexküll is deeply influenced by Kant (Plessner 1975: 250; on p. 69 the biologist is defined as "the "Kantian" Uexküll"). As we have already seen regarding Scheler, this side of Uexküll is not easily compatible with the intents of philosophical anthropology, not only because it considers the animal subject along the lines of the rational Kantian subject but also because it risks rendering different environments as closed and incommunicable spheres.

After having recognized these core problems, Plessner has to take a position on them. As for the first point, Plessner's strategy is to widen the concept of transcendental structure in the anti-intellectual sense, especially in the direction of admitting the existence of a priori material (what within certain limits respects the Uexküllian coordinates):

> If it turned out that the laws of the relationship between living being and world, the laws of harmony, the laws of correspondence and of the common original design really did exist, and that they were based on [. . .] the essential structure of life, i.e. a priori material

[5] Worth of mention is also Plessner's statement that Uexküll's scientific program is to give a "phenomenology of living behavior" of animals (Plessner 1975: 63).

> laws, then we would have to conclude that they should have the importance of categorical laws. [...] Why should it be forbidden to free the category's function of its particular specialization as form of thought or form of knowledge, in order to raise the problem of categories or categorical functions that belong to other, more primitive or essential levels of life? The idea that there are a priori forms, categories of existence, vital categories that belong to the preconscious deeper levels of existence of life carriers and organisms (meant not as objects, but as living subjects), from which convergence and correspondence between organism and environment stem? (Plessner 1975: 65–66).

In Plessner's opinion, Uexküll's mistake – and this is the second danger connected to the Kantian legacy inherent in his theoretical biology, specifically environmental solipsism – was considering the a priori material not as part of the relationship between organism and reality, but as a structure of the animal subject that only in a second moment would be transposed or projected to the outside. Plessner is very direct here: "Uexküll is not right when he claims that "the Umwelt – inasmuch it is reflected in the animal's object world – is always a part of the animal itself" [...]. This would be in a way zoological idealism. The place of a world-creating conscience would be token by a world-creating organization" (Plessner 1975: 259). This criticism is directly aimed at the strategy deployed by Uexküll when he postulates the existence of a regulator *Naturfaktor*.

Plessner is similar to philosophical anthropology in general in that when the discussion shifts to humans, Uexküll's influence thins to the point of almost disappearing. To Plessner, the environmental categories, including the ones for higher animal environments, appear inadequate in precisely identifying the *Sonderstellung* of the human being. Coherently with the general theory of the living that he created, he traces that specificity in an original and special way of relating man with his own limit, the eccentric position. For eccentricity of man, Plessner intends his awareness of being divided into an inner and outer sphere and the creation of a center of representation and action (the ego) that no longer coincides, as does with animals, with the center of the nervous system. Therefore, man is a decentralized being that – without abandoning the central position of the animal form – knowingly *lives* it and, in doing this, sets himself outside of it.

7.1.3 Gehlen

A confrontation with Uexküll can be found in the central chapter ("Animals and their Environments. Herder's Contribution") from the most important philosophical-anthropological text by Arnold Gehlen, *Man. His Nature and Place in the World* (Gehlen 1988). Like Plessner, Gehlen's references to Uexküll play a highly important role in the philosophical definition of animality, that is to say, within the processing of the theoretical background where the qualitative difference of humans is contrasted against. This way the elements of the Uexküllian *Umweltlehre* are used with a general intent that is different from Uexküll's, who supported instead a gradualistic concept of the difference between animal environments and human environments.

Gehlen's presentation of the Uexküllian concept of the environment – a well-examined presentation full of examples from the second edition of *Umwelt und Innenwelt der Tiere* and also *A Foray into the Worlds of Animals and Humans* – pivots on the idea that the Estonian biologist is a representative "for the modern view of a harmonic relationship between animals and their environments" (Gehlen 1988: 65). As a precursor of this line of investigation about the nature of animals, Gehlen points to Schopenhauer, who believes that will is immediately translated into sensorial and anatomical organs according to the ecological and biological possibilities that it wants to explore. The reference Gehlen proposes is undoubtedly justified: as we saw, in Uexküll's texts on theoretical biology will plays a key role in more than one way (see *above*, 111). It is also significant that Schopenhauer is brought up in the same passage as acknowledgements to Uexküll and Kant are mentioned: "Independently of Schopenhauer (but not, by his own admission, of [some ideas by] Kant) Jakob von Uexküll [. . .] has examined the relationship between the structure of an animal's organs and its environment" (Gehlen 1988: 65).

The caution when clarifying the extent of Kantian influence – that is clear from that "some ideas", and which recalls Plessner's choice to put the appellation "Kantian" in quotation marks, referring to Uexküll – and underlining the connection, which is theoretical if not historical, with Schopenhauer show that Gehlen wants to give the least possibly transcendental, and the most possibly "realistic" reading of the theory of the constitution of environments. As occurs in Scheler, it is not by accident that also for Gehlen what is most emphasized in the environment is that it is the result of a selection from an external reality, while the Uexküllian passages that attest to how it is the product of the synthetic and constitutive action by the subject itself are not acknowledged.

This combined strategy has a well-defined goal: to go beyond Uexküll by showing how the environments are, in fact, subjective worlds but not pure phenomenon. This emerges from a passage in which, after presenting the positive aspects of Uexküll's environmental theory, Gehlen goes on to formulate a criticism that involves the Estonian biologist as much as his continuators. In that criticism, the first charge is of excessive subjectivism:

> [Because of Uexküll's influence,] the tendency at this time was increasingly towards studying the unique environments of animal *subjects*; the actually quite productive behavioral research receded while the Kantian substructure of theory prevailed ("All reality is subjective appearance"); Uexküll and the school later even worked with the idea of Leibniz's monads (Gehlen 1988: 70; italics by Gehlen).[6]

Therefore, looking closely, Gehlen criticizes Uexküll not only for his phenomenism (that comes from the Kantian transcendental school) but also for the numeric multiplication of monadic subjects – that, at least in the animal world, would be Schopenhauerianly set against a unique metaphysical subject, the will. The two criticisms reinforce each other because the solipsistic closure of every

[6]The last reference is to Uexküll's pupil, Friedrick Brock (see Brock 1934).

single subject in the environment requires the action of "strong" organizing forces that, however, as in the case of the Leibnizian pre-established harmony, can best complete their function only in an idealistic or spiritualistic context.

The charge that the concept of the subject remains abstract in Uexküll (a Kantian and, before that, Cartesian legacy) is therefore a common aspect for all three authors that have been examined so far; in fact it should not be forgotten that they firstly aim to get back the physical dimensions – or better yet, the psycho-physical unit – of human beings. Certainly, it would be opportune to carefully evaluate if they really understand the material elements that Uexküll puts among the a priori structures of the animal subject (conceding that they are sufficient to avoid the risks of solipsism inherent in the Kantian position); all things considered, for the philosophical anthropology the Kantian legacy appears to be an inconvenient, or at the very least a not easily usable, part of the Uexküllian conception.

Gehlen also agrees with Scheler and Plessner in the critique of Uexküllian gradualism in his view of the relationship between man and animal. His observations are meant to show, in an original way, how the intraspecific variability of man's living environments (admitted also by Uexküll) make him a being that is qualitatively different from animals:

> Another, equally significant fault in Uexküll's theory is that he attempted to apply it to man; for example, he presented the well-known idea that a forest means something different to a poet, hunter, lumberjack, lost person, etc. [...] In doing this, a distinction of great relevance is lost. The original, truly instinctive behavior patterns of animals, which are tied to specific natural environments, are confused with an *acquired* specialization of behavior in man which is his response to a finely structured cultural sphere (Gehlen 1988: 119; italics by Gehlen).

Here Gehlen handles a problem that we have looked at previously: whether it is legitimate or not to equate the variability of meanings that the same object or physical context can perform in the various functional circles of an animal with the cultural variability that is deployed in the world of humans (see *above*, 153). Unlike Merleau-Ponty, who sees the multiple biological functions that the sea anemone performs for the hermit crab as a beginning of culture, Gehlen keeps the two types of semantic variability quite distinct from each other – and this also in the cases where the human modalities of environment interpretation reach such a level of stability that they appear "natural" or "instinctive" rather than cultural.

In Gehlen, this combination of problems is connected to the topic of institutions, i.e. all those ways of stabilization of the conduct that allow man – that, in himself, is a being of plastic behavior, without the natural guide of instincts – to channel individual and group action and make it reliable (thus ensuring the survival of the species through a way that is unusual for the natural world: the cultural way). Yet, this limits the usefulness of the concept of Umwelt in the analysis of the human sphere:

> The highly cultivated and irreversible attitudes that Uexküll describes can exist only within a firmly institutionalized cultural system; and then the concept of "environment" [Umwelt] is totally unbiological and can only mean something along the line of a highly civilized individual milieu. The clearly defined, biologically precise concept of environment is thus

> not applicable to man, for what "environment" is to animals, "the second nature", or culture, is to man; culture has its own particular problems and concept formations which cannot be explained by the concept of environment (Gehlen 1988: 71).[7]

Therefore, according to Gehlen, the analogy between the animals' environmental experience, consistently determined by the building-plans and by a strict repartition into functional circles, and the cultural elaborations of reality that make up human history is only apparent. More precisely, it is a sort of mistake in perspective coming from the important stability that, at least during the pre-modern era, characterizes cultural forms and institutions. Here, Gehlen's anthropological reflection is combined with his original evaluation of modernity, where the denunciation of the extreme subjectivism and of the lack of shared cultural and institutional reference points of modern time play a primary role. Even if it is not possible to expand on this point, it should be said that once compared to the Gehlenian concept of modernity, Uexküll's environmental theory seems even less applicable to man; if Gehlen brings us to consider the extremely subjective variability of experience as an essential aspect of the modern – and this is not only between one individual and another, but also between one phase and another in the biographical development of the subject – it will be more and more difficult to identify typical experiences that, because of their stability, can arouse the impression of instinctual unchangeability in us.

In this way, the criticism advanced by all philosophical anthropology, that Uexküll did not manage to grasp the specificity of man, appears to be further radicalized in Gehlen. If the notion of Umwelt could be valued at least as an analogy for the pre-modern man, for the "late culture" man it is actually deceptive, because it has us postulate a misleading stability of cultural processes and subjective interpretations. In other words, it is no longer guaranteed that the individual experience of the woods, by a young girl or a woodsman, is the one that we would expect based on fixed, codified criteria. Incidentally, according to Gehlen, it is not by accident that modernity witnessed the creation of psychoanalysis, here seen as a personalized technique of analysis of lived environments that is both symptom and cure for the state of extreme fragmentation of the experience which followed the end of traditional societies (see Gehlen 1980: 159–164, 2004: 118).

7.1.4 Cassirer

In the late 1920s, Ernst Cassirer was one of the most constant external attendees of the *Institut für Umweltforschung* in Hamburg and he was linked to Uexküll

[7] It should be noted how, to indicate man's cultural environment, Gehlen uses the sociological term milieu, i.e. the same term that Uexküll had tried to transmit into biology during the initial stage of his thinking (see *above*, 63).

by a relationship of respect and friendship.[8] Along with a personal understanding, Cassirer considered Uexküll's thinking with great attention, interpreting and using it not only within the theoretical coordinates of philosophical anthropology, but also in an epistemological-methodological key. The main texts where Cassirer deals with Uexküllian theoretical biology are the second chapter of the (planned) fourth volume of *The Philosophy of Symbolic Forms*, which was written in 1928 and bears the title of *The Problem of the Symbol as the Fundamental Problem of Philosophical Anthropology* (Cassirer 1996: 34–111), the 1940 work *The Problem of Knowledge. Philosophy, Science, and History Since Hegel* (Cassirer 1969) and *An Essay on Man* in 1944 (Cassirer 2006).[9] If the first and third texts knowingly place themselves in the viewpoint of philosophical anthropology and therefore refer to Uexküll in pursuit of clarifying animality and the qualitative difference of man, the second text offers an accurate analysis of Uexküll's methodological principles and their value in modern biology.

We shall start with the epistemological problem, which later on will allow us to come back to the anthropological question. Cassirer sees Uexküll mostly as an exponent of vitalism – "Uexküll is a resolute champion of vitalism; he is a defender of the principle of the autonomy of life. Life [. . .] cannot be described or explained in terms of physics or chemistry" (Cassirer 2006: 28) –, but he attributes a version of vitalism to Uexküll that is so-called "weak", unconnected to any hypothesis on the existence of extra-material forces and lacking any recourse to their effectiveness in explaining natural phenomena. In other words, in Cassirer's opinion, Uexküll most likely moves along a synchronic (or "static") level in the morphological analysis of the living, without challenging himself to a diachronic or "dynamic" one in the pursuit of causal connections with the last teleological forces (in this respect, Uexküll is clearly placed in contrast with Driesch): "The emphasis of Uexküll [. . .] was not, however, upon the *development* of the organism [. . .] but upon its *being*, and the center of gravity was shifted accordingly from the dynamics of living beings, that is, from physiology and phylogenetics, to the statics thereof" (Cassirer 1969: 199–200).

Once the causal function of the extra-material organizational forces is removed, what remains as truly vitalistic in Uexküll's approach is, according to Cassirer, the accentuation of the teleological character and the formal autonomy of the organic phenomena, which translates in the centrality of the concepts of building-plan and morphologic schema. "Once we have clearly explored the structure of an animal in all its features" – observes Cassirer – "the whole being and mode of existence of the

[8] See *above*, 34, n. 83, Cassirer's amused reaction to Uexküll's conference on the behavior of territorial marking by the domestic dog.

[9] Then the briefer text has to be mentioned from the conference, *The Fundamental Problems of Philosophical Anthropology*, held at Davos in March, 1929, whose publication is foreseen in vol. 17 of Cassirer's *Nachlass.* For the relevance of that conference for the reception by Heidegger of Uexküll's biology, see *below*, 198. For the complete list of reference by Cassirer to Uexküll, see Krois 2004: 277–278.

animal is revealed" (Cassirer 1969: 201). This knowledge covers the Umwelt of the studied organism, which Cassirer correctly sees as an extra-corporal offshoot of the building-plan that branches off in the two fundamental directions of perception and action.

To this end, Cassirer observes that the method used by Uexküll to investigate animal environments without falling into psychologism is "objective or behavioristic" (Cassirer 2006: 28) while not being reductionistic. This judgement, which is very close to Lorenz's (see below, 221–222), is expressed in a very meaningful way by Cassirer: "The only clue to animal life, [Uexküll] maintains, is given to us in the facts of comparative anatomy. If we know the anatomical structure of an animal species, we possess all the necessary data for reconstructing its special mode of experience" (Cassirer 2006: 28).[10] It should be said that when he mentions anatomy, Cassirer intends the total body structure in a wider-than-usual meaning. The 1928 text defines the same structure using the Uexküllian word "building-plan" that, however, does not appear in *An Essay on Man* (see Cassirer 1996: 43).

Within a wide-reaching strategy directed at correcting contemporary biology and zoology, diminishing the excessive mechanicism through the recovery of positive contribution by the "idealistic morphology" (Cassirer 1969: 200)[11] and the Goethian concept of form, Cassirer concentrates on three fundamental epistemological principles from the Uexküllian approach. The first consists of the idea that the study of animal environments must go beyond the naïve anthropomorphism of those who presume that every organism perceives and reacts in a structurally analogous context compared to humans. Mentioned several times, this idea is however dismissed in an original way by Cassirer in that he – by agreeing with the Uexküllian thinking – dedicates ample space to the problem of the "thingness" of perception: the human observer usually supposes that animals also move in a perceptive context consisting of stable and lasting aggregates, and quality-bearing substrates – things, in fact. As Cassirer points out, Uexküll correctly understand that the building-plan of animals rather leads to receiving single qualities without substrate (if this is true for lower animals, a different argument would need to be made for a Uexküllian analysis of perception in higher animals, but Cassirer does not have the instruments to deal with it, perhaps

[10]Establishing a very original theoretical connection, even though it is not supported by significant textual validation in Uexküll's work – except in the article about Nature-God in Goethe (see von Uexküll 1923) and the reference to Goethe's verses "Were the eye not sunlike [*sonnenhaft*]/it could never gaze upon the sun" (von Uexküll 2010: 190; see also Goethe 1982: xx) – Cassirer compares the importance of anatomy in Uexküllian theoretical biology with the Goethian use of morphology as the key access to the living. This set of relationships is well described in Krois 2004: 282, 284–285.

[11]For "biological idealism" and Uexküllian phenomenalism, also see *An Essay on Man*: "As a philosopher he [Uexküll] is an idealist or phenomenalist. But his phenomenalism is not based upon metaphysical or epistemological considerations; it is founded rather on empirical principles" (Cassirer 2006: 28).

because he is considering the second edition of *Umwelt und Innenwelt der Tiere* and *Theoretische Biologie* and not *A Foray into the Worlds of Animals and Humans*).

The second principle involves the epistemological enhancement by Cassirer of Uexküllian vitalism, a vitalism that (as we have seen) would not place itself on the level of diachronic and causal analysis, but on the synchronous level of the structural study and of the highlighting of the autonomy of the form. Facing a functional circle or another biological phenomenon, in other words, Uexküll does not look for the final cause, but rather for the organizational rule:

> There was no need for him to introduce any special purposive "forces": it was enough to prove that the living world, in its totality and in its details, has a stable teleological *structure*. In this sense he preferred to speak of "structural character" rather than purposive character [. . .] He was interested in the fact that there is a nonmaterial ordering, a rule of the living process (Cassirer 1969: 200; italics by Cassirer).

Despite it being consistent with the definition of building-plan found in Uexküll's early work and the criticism of excessive metaphysicality that the Estonian biologist applies to the Drieschian notion of entelechy (see *above*, respectively 50 and 62), Cassirer's judgement does not agree with the many textual passages where Uexküll resorts to forces such as the natural factor and the will, as we highlighted when we talked about embryology and the theory of Uexküllian action (see *above*, 121 and 115). More than to find a way out from the causal level, as Cassirer would like, Uexküll attempts to move the last causal factors away from phenomenal reality by inserting an intermediate level (specifically, that of forms, shapes, building-plans and behavioral rules). However, as we have seen in the case of protoplasm and controlled action, sometimes Uexküll also admits direct intervention (even though blind and unaware, just like being part of the building-plan is blind and unaware) of the last organizational forces on the phenomenal level. And it is difficult not to attribute a causal character to such an intervention, and causal in the teleological sense: it is true that Uexküll privileges the conformity to a plan rather than purposiveness or goal-directedness, but in order to be such, a plan must have a goal. If we take a closer look, actually, the "weak" teleology that Cassirer attributes to Uexküll leads to true finality.

The third epistemological precept that Cassirer draws from the Uexküllian theoretical biology is the intent to widen the teleological approach from the single organism to the universal inter-organism level, in a sort of transposition of the Leibnizian predetermined harmony in biology:

> [Uexküll] created a new conception of "the biological universe", which he compared with that of the "astronomical universe": the latter "is but one world whose infinite space and everlasting time hold countless stellar mechanisms aimlessly revolving around one another; the biological universe presents a picture instead of thousands upon thousands of self-contained worlds that are related to one another according to a plan of unexampled grandeur" (Cassirer 1969: 205; the quote is from von Uexküll 1930: 157).[12]

[12]The closure of the environment-monad is also highlighted in *An Essay on Man*: "Every organism is, so to speak, a monadic being. It has a world of its own because it has an experience of

Let us now come to the second point in our analysis of Cassirer's interpretation of the Uexküllian theoretical biology, specifically the anthropological question; in different ways, we will find many of the problems that we encountered when discussing Uexküll's influence on philosophical anthropology in the strict sense (i.e. on Scheler, Plessner, and Gehlen). We can start from the 1928 text, which is the closest to Schelerian and Plessnerian subject matter. After recalling that Uexküll believes the species-specific organization of animals involves a receptive system and an operative system connected to each other in functional circles, and that (even in its isolation) this organization assures the animal a reliable and organic integration (*Einpassung*) in its environment – Cassirer states that this set of concepts is not transferable to man and his world. Basically, from Cassirer's viewpoint,

> this approach of research [...] can take us no further as soon as we turn to the basic problem of "philosophical anthropology". The concept of mankind is defined for it not by any specific, identifiable structural features, but through the comprehensive totality of mankind's achievements. The totality of these achievements can in no way simply be read off by mankind's "organization" ["*Bauplan*"], such as from the organization of the brain and of the nervous system (Cassirer 1996: 43).

Starting from the realization (valid for the texts Cassirer knew) that Uexküll, "conducted his research primarily in the area of the lower animals" (Cassirer 1996: 43), and introducing in the analysis a term which Uexküll profoundly disagrees with, Cassirer describes the life form of animals as a kind of blurred instinctual life (*Triebleben*): "These drives alone ignite the torch by whose light the animal is able to distinguish specific configurations in the world surrounding it" (Cassirer 1996: 44).[13] And it is especially the closure of the functional circle, both perceptive and operative, that appears to Cassirer as particularly inadequate in describing man's reality. To this end, he notes that "this interrelation of "noticing" and "effecting" appears to loosen up the more we approach the human world until finally, in this world, even the bond that otherwise everywhere defines the unity of the organism seems to vanish" (Cassirer 1996: 44).

This way, regarding the cognitive relationship with reality, man seems to leave the sphere of perception as "mere noticing" in order to conquer the realm of "observation" (Cassirer 1996: 44); this step allows external data to be presented to the human being not as isolated signals aimed at triggering an action according to the rules of the *Bauplan*, but as autonomous and permanent objects. Two topics return here: the overcoming by man of a modality of perception intended as "a chain of stimuli" and the appearance in him of thing-like perception. Cassirer sees them as a necessary condition for one of the most important acquisitions in human beings – the perception of oneself based on the symbolic representation of the self:

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its own. [...] The experiences – and therefore the realities – of two different organisms are incommensurable with one another" (Cassirer 2006: 28).

[13]This vision, which Cassirer transmits to Heidegger during the Davos convention in 1929, will be extremely important in the formation of Heideggerian concepts of captivation and disinhibiting ring, that tend to highlight the automatism of animal life (see *below*, 198).

"only by positing something that remains fixed in space is the notion of an enduring I possible, one which remains identical with himself in all its successive states" (Cassirer 1996: 64).

The need to develop for man categories of investigation which are independent even from the Uexküllian biology is confirmed, in different ways, in *An Essay on Man*. In this text, Cassirer states:

> In the human world we find a new characteristic which appears to be the distinctive mark of human life. The functional circle of man is not only quantitatively enlarged; it has also undergone a qualitative change. Man has, as it were, discovered a new method of adapting himself to his environment. Between the receptor system and the effector system, which are to be found in all animal species, we find in man a third link which we may describe as the *symbolic system*. This new acquisition transforms the whole of human life (Cassirer 2006: 29).

The interest in the qualitative difference of man, which is typical of German philosophical anthropology, weaves into the subject of the man as *animal simbolicum*, which is central in Cassirer, and the conceptual distinction between a signal (reference point to external objects also found in the animal world) and a symbol, which instead is peculiar to man. If the signal is limited to substituting, to *standing for* an external object in the perceptive environment of animals and therefore does not have an autonomous existence on a representative level, the symbol (and most importantly the linguistic symbol[14]) persists in man's mind, creating a world that overlaps perception and acts as mediator between perception and action.

In Cassirer's opinion, the rise of a cognitive system based on symbols leads to a break with the environment intended in the Uexküllian sense; between the environment perceived by animals and the symbolic world of man (that includes language, myth, art and religion), an abyss opens, because:

> in the first case a direct and immediate answer is given to an outward stimulus; in the second case the answer is delayed. It is interrupted and retarded by a slow and complicated process of thought. [...] No longer can man confront reality immediately, cannot see it, as it were, face to face. Physical reality seems to recede in proportion as man's symbolic activity advances. Instead of dealing with the things themselves, man is in a sense constantly conversing with himself (Cassirer 2006: 29–30).

In conclusion, Cassirer's position toward Uexküll's work appears difficult to reduce to a unified vision. On one hand, he draws from Uexküllian theoretical biology precious methodological and epistemological information that he intends to propose to the biology and philosophy of life which is contemporary to him as corrections to the excessively mechanical approach, pivoting exclusively on antecedent causes and blind to the considerations based on the ideas of form and structure. Cassirer's reading of Uexküllian vitalism appears as too anxious to

[14]In the current panorama of cognitive science and philosophy of language, there do not lack scholars, such as Felice Cimatti, who believe that it is specifically language that is responsible for the radical redefinition of human perception around things as centers of identity (to this end, see Cimatti 2002).

distance it from the metaphysics of forces and entelechies; maybe exactly because of his willingness to use Uexküll this way, however, his warning that the *phenomenon* (although not the final causes) of the teleological organization of the living does not stray from the biologist's field of experience is surely a fertile and positive feature. This was the perspective of his attempt to draw Uexküll closer to Geothe's *Naturphilosophie* and Kant's *Critique of the Power of Judgement,*[15] which is valid from a theoretical point of view but not supported by significant textual references.

On the other hand, like most philosophical anthropology, Cassirer tends to overlook the legacy of the first Kantian criticism in the Uexküllian thought: perception by lower animals is seen as a selection of external reality and not the result of a constituent activity, even if elementary, and only man is considered capable of introducing a cognitive-symbolic mediation between stimulus and action. In general, the danger of homogenizing man with other forms of animal life has Cassirer overestimate the importance that Uexküll would give to anatomical and physiological analysis, disregarding the rich and clear reflections about time, space and other structures a priori which can also be found in the works read by Cassirer (above all in *Theoretische Biologie*; see *above*, 108). In the end it must be said that the interpretive line aimed to highlight the specific difference of man would have proved much more difficult to endorse on the basis of the discussion about higher animals in *A Foray into the Worlds of Animals and Humans* and of the topic of meaning in *A Theory of Meaning*, where concepts like the magical environment or operating image make it very difficult to attribute to Uexküll (even indirectly) the idea that animals have to do only "with things themselves", and that only mankind can elaborate reality in a meaningful way.

7.1.5 Langer

The American philosopher Susanne Langer (1895–1985) deals with Uexküll in *Mind. An Essay on Human Feeling*, a text where the intent of German philosophical anthropology and Cassirer to determine the specificity of the human being in the living world (and most of all in relation with animals) is accompanied by an interdisciplinary investigation on the cognitive and ethological origin of that specificity (Langer 1967, 1972, 1982).[16] Following some of Cassirer's issues in original ways, such as the distinction between signals and symbols, in *Mind. An Essay on Human*

[15] After noting that, for Uexküll, it is necessary that biology includes teleology in its own theoretical kit, Cassirer comments, "[In this way] Uexküll returned much more nearly to Kant's position and his solution of the problem of purpose than Driesch had ever done. No objection to this view could have been found in the *Critique of the Power of Judgement*" (Cassirer 1969: 203). However, as we have seen, in Uexküll the direct references to the *Critique of the Power of Judgement* are scarce and generic.

[16] For an introduction to the person and work of Susanne Langer, see Brentari 2007; for the relationships between Langer and Cassirer see Brentari 2007: 27–29.

Feeling Langer tries to reconstruct the steps that led from animal organization, based on the immediate reaction to the sign-stimulus, to a human world made of persistent and complex symbolic representations, that already come into play on a perceptive level and shape the entire human experience. The specificity of man is attributed by Langer to its particular cognitive organization, but not in the sense of a mere reference to the fact that man reasons: *feeling* is much more important for Langer, specifically the way in which the surrounding world is "felt", i.e., reperceived and elaborated.

In this context, Langer refers to Uexküll with two main intents. In the context of a complex theory of the living that is developed in the first volume of *Mind. An Essay on Human Feeling*, the Uexküllian Umwelt appears to the author as an exemplary model of organic system, a system in which the causal forces at work are essentially different from the ones that determine inorganic matter. In particular, the interposition of the environment between external reality and organism ensures that the relationships between these two poles cannot be considered as direct causal influences anymore, of a mechanical sort, but as induction and motivation of processes (for a more detailed explanation on the subject, see Brentari 2007: 106–108, 145–159). Even if the Uexküllian concept of species-specific environment is mentioned (and to this end it should be observed that Langer, following the major interpretive trend, attributes the diversity of the environments to the selective action of the sensory organs), the author's attention rests on the relativity of the biological value that the same stimulus can assume at the moment in which it enters in a living system.

Therefore, in Langer's opinion, the environment is firstly a matrix of organic processes in progress – which in Langerian terminology are called "acts" – that mediate and modify the external factor's action on the organism, making it extremely variable on a case-by-case basis. From this derives a unique reading of the Uexküllian concept of Umwelt that focuses on its systemic characteristics:

> Jakob von Uexküll called attention to the fact that two different organisms in the same environment were likely to exist in widely differing environmental situations, or, as he called them, different "*ambient words*" ("*Umwelten"*) due to the selective powers with which their respective peripheral organs [...] could filter out noxious or even merely useless influences. [...] Besides these differences in the reception of outside influences, there is an immense variation in the value an influence, once received, has for various creatures. This is because the external event can keep its formal self-identity only to the point of making peripheral contact whit the system [...]; if it invades that system (as, for instance, [...] a rise in temperature may be propagated inward from the contact surface), that importation falls at once under the sway of the vital processes and becomes an element in a new phase of the organism; that is, it engenders a new situation (Langer 1967:282–283).[17]

[17]In conclusion to this commentary, Langer proposes the English translation *ambient* for the word Umwelt; if she herself, in the latter volumes of *Mind. An Essay on Human Feeling*, will adopt this translation, the same does not happen in the remaining literature dedicated to Uexküll in the English language.

We find here, integrated in the Langerian theory of the living, Uexküll's idea that the value of a stimulus depends on the functional circle where it is placed. Even though she does not quote the texts that could have supported her references best (above all *A Theory of Meaning*[18]) and limits herself instead to mentioning the first edition of *Umwelt und Innenwelt der Tiere* and (curiously) *Nie geschaute Welten,* (von Uexküll 1936) here Langer uses a real feature of the Uexküllian thinking that ultimately derives from the anti-mechanistic inspiration of the Estonian biologist and from his refusal to admit that "automatic" relationships between stimuli and responses exist for living beings. However, the adoption of the Langerian coordinates leads to losing Uexküll's central connection, the one between the environment and the animal subject that molds it; in Langer, the animal, like all living organisms, it is not a subject but a system.

The second way Langer uses the Uexküllian concept of Umwelt is as a valid contribution to her definition of animality. In the second volume of *Mind. An Essay on Human Feeling*, Langer shows how, even compared to the same basic dynamics, living systems find themselves on different organizational levels (the last one being the human sphere, with its special vital organization based on symbols). Uexküll's contribution, evident from the title that opens the discourse on animality ("Animal Acts and Ambients"), appears strongly mediated by Cassirer's influence here: the question of the animality's essence is, in fact, almost entirely connected to the issue of the non-thingness of the perceived experience of animals.

In this investigative perspective (and often leaving out the complexity of Uexküllian thinking), Langer identifies the central point of the problem of environment in perception: "to understand a creature's aim and methods one has to consider in what sort of Umwelt it lives, that is, what it is likely to perceive" (Langer 1972: 45). The investigation of perception, however, is not intended only as the analysis of the differences in the vision and hearing fields of different species, but as the comprehension of a possible alternative structuring of the perceived, which in animals is different from humans. In particular, according to Langer as well as Cassirer, the central elements of human perception are the unity and identity of the objects, their precise collocation in space and time and the causal connection between distinct events. Therefore, due to his representative-symbolic capacity, man moves in a world of unitary perceived constructions that possess a stable identity; they can change, but in normal conditions, it is clear that "behind" the changes of state and quality, there is a persistent, thing-like and uniform substratum.

On the other hand, animal experience is far more fluid, based on the appearance and flow of overall "lived situations" determined by single qualities, which take on a hegemonic role even without being attributed to a determining object (for

[18]It is very possible that Langer did not know about this text; in the second volume of *Mind. An Essay on Human Feeling*, in fact, she cites the first English translation of *A Foray into the Worlds of Animals and Humans* (see von Uexküll 1957) that does not include *A Theory of Meaning.* As we said before, however, the concept of relativity of value in environmental elements is nevertheless to be found even in *A Foray into the Worlds of Animals and Humans*.

a more detailed analysis on the subject, see Brentari 2007: 159–183). Among the scholars who have gone into more depth in the comprehension of the non-thingness of animal perception, Langer mentions – alongside Uexküll – above all Thorndike,[19] Krueger[20] and Volkelt.[21] The most space is given to Volkelt, who believes that animals have a perception that is not structured in centers of identity and where single things perceived are not important, whereas the quality of the whole (*Komplexqualitäten*) is. These qualities are generically described as "atmospheres" or "colorations" of the environment. For Volkelt, they are "diffuse and unstructured" (Volkelt 1912: 90), but at the same time, clearly distinguishable from each other – the way in which each motive in a melody is perceived as different from the others even without having the notes that it is composed of clearly distinguished from each other. The animal appears to orient its own behavior following the rise, continuation and disappearance of a general quality. If the rise – or "accumulation" (Volkelt 1912: 23) – of a totally new quality is determined by the appearance or disappearance of single elements of the whole, those onsets and disappearances are not perceived as such, but rather as mutations of the total environmental atmosphere (to which the animal knows how to react with incredible finesse).

Looking at Volkelt's intuitions, Uexküll's substantially appear to Langer as preparatory. Although it is true that, in his research on lower animals, he realized that animal environments can be made up of not objects but single stimulus, this discovery was not radically new:

> Jakob von Uexküll has startled the philosophers and psychologists of his day with his reflections on how different the *Umwelten* of infusorians and the lowest metazoans must be from those of higher animals, say, the mammals, but his insights were, after all, not hard to accept if one considered the sensory apparatus of the little creatures he studied. Thorndike's cats were more baffling; it is much harder to believe that cats and dogs may not see chairs and tables, cage doors and corridors just as we see them (Langer 1972: 55).

The same stance is also reaffirmed in Langer's comment dedicated to Uexküll's studies about the perceptive world of the fly; the author's textual reference is *A Foray into the Worlds of Animals and Humans*, where an illustration used by the Estonian biologist tries to graphically represent the perceptive differences between the insect's environment and man's. The following are Langer's words:

[19]Edward Lee Thorndike (1874–1949). Psychologist and behavior scholar who dedicates himself primarily to the study of learning processes in animals, that he interprets in terms of radical associationism (which makes him one of the precursors of American behaviorism).

[20]Felix Krueger (1874–1948). German psychologist who dedicates himself primarily to the study of primeval perceived and emotional experiences in man, which appear to him as *Gestalt* qualities that are no longer analyzable. His holistic approach, oriented as it is toward the overall structure of the studied phenomena, makes him one of the predecessors of *Gestaltpsychologie.*

[21]Hans Volkelt (1886–1964). German psychologist and pedagogue, he conducts research on animal and human perception, ranging from principles close to the *Gestaltpsychologie* approach; very importantly, he adopted holism as a methodological and theoretical principle.

> Jakob von Uexküll has made some brave attempts to imagine and picture non-human ambients; but selective simplification and different degrees of detail in humanly recognized 'things', are all the differences between the so-called objective environment and the various animal *Umwelten* that he managed to render graphically (Langer 1972: 32).

When faced with these references, Langer's interpretation of Uexküll does not appear to be very in depth. Firstly, it is significant that, even though *A Foray into the Worlds of Animals and Humans* was available, the author limits her criticism to an illustration that is actually secondary and does not dedicate the least attention to the theories that the text contains about the structure of higher animals' environments. If she had done so, it might have allowed her to recognize much larger merit in Uexküll than having determined the non-thingness of lower animals' environmental perception. Of course, Uexküll's concept of environment does not include the attribution of such a perception to higher animals, but that does not necessarily mean that they move in the same environment as humans. As we have seen, Uexküll's position in *A Foray into the Worlds of Animals and Humans* is much more complex, and maybe it is this complexity – that culminates when it shows the many areas in common between the environments of higher animals and man – that could have put Langer and Cassirer's line of interpretation into question, jeopardizing their conception that between animal and man there is a unsormontable cognitive difference based on the ability of the latter to organize the perceived through symbols and stabilizing thing-like representations.

7.2 Uexküll in Twentieth Century Philosophy

7.2.1 Heidegger

Martin Heidegger was one of the listeners at Cassirer's conference in March 1929, *The Basic Problem of Philosophical Anthropology*, where the references to Uexküll play a central role. A few months later, Heidegger used Uexküll's theories in the 1929–1930 winter semester course in Freiburg.[22] The course, that was published under the title *The Fundamental Concepts of Metaphysics. World, Finitude, Solitude* (Heidegger 1995), pivoted on an ontological distinction between things, animals and man: regarding the last two types, the aspect which Heidegger give more importance to is the relationship between the being and its context, and the concept of *Umwelt* appears here. Coherently with the circumstances in which Heidegger came into contact with Uexküll's thinking, the influence of Cassirer was clearly perceivable in the course (most of all, as we will see, in the accentuation of the closure of the animal in the circle of instinctive life).

[22]For more details about Cassirer's conference and its relationship with the Heideggerian reaction to Uexküll's thinking, see Krois 2004: 278–279. For an orderly and complete dissertation on the Heideggerian interpretation of Uexküll see Bassanese 2004.

We should immediately point out that Heidegger's interest in the Uexküllian theoretical biology is explicitly oriented toward the contribution that it can offer to solve a question that Heidegger articulates in a clearly metaphysical manner: the relationship between man and world. In *The Fundamental Concepts of Metaphysics,* this relationship, central for Heidegger already since *Being and Time*, is dealt with in the particular prospective of a comparative analysis. In other words, if man is the builder of the world, i.e. he is the being that requires, in its essence, the opening of a world around him, then it will be a question of investigating how things are for inanimate objects and animals. According to Heidegger, for the essential understanding of material things, for example a stone, the concept of world is irrelevant, while it begins to acquire importance for the animal. This is because the stone, even though it has multiple physical relationships with other beings, does not *behave* toward them as a unitary and centrally organized system. This is possible, instead, for the animal, which poses the problem of *interpreting* the modality of the relationship of the latter with other beings and the environment, i.e. the problem of the animal's "being referred to" the other – a reference that Heidegger defines as "poverty in world [*Weltarmut*]" (Heidegger 1995: 194).

In general, the problem of the relationship between the animal and what surrounds it can be dealt with from two perspectives. In the first, one can investigate *how much* the animal perceives from the environment; it is the line of investigation followed by all the researchers that are dedicated to the quantitative measuring of the wavelengths heard by an animal, or the color spectrum that it can see. In the second perspective, which is much more complex, one tries to understand how the animal *experiences* what it perceives, how it categorizes the perceived; even though some of the interpreters believe the opposite, this is the line of investigation that Uexküll follows, which sees in it a fecund application of Kantian transcendental philosophy to biology. Distant as they may be, these two perspectives (quantitative and qualitative) share a basic methodological premise: the concrete relationship between animal and environment is firstly perceptive (as we have seen, this is the point on which Scheler, Cassirer and Langer focus their attention). At first glance, it seems like Heidegger can also be put into this schema. As he strongly refuses the first stance, stating that the "poverty in world" is not intended as a mere quantitative limitation of the perceived environment, he seemingly belongs in the second; that is to say, as far as the relationship with the environment is concerned, he also seems to believe that the difference between man and animal is based on perception.

In order to clarify this point, it is necessary to go into more detail about what Heidegger really wants to say in *The Fundamental Concepts of Metaphysics;* this allows us to simultaneously understand the way in which he adopts Uexküll's theories. First of all, even though he uses some elements of it, Heidegger opposes the Estonian biologist's general position from the beginning: "Since J. v. Uexküll we have all become accustomed to talking about the *environmental world* [*Umwelt*] *of the animal*. Our thesis, on the other hand, asserts that the animal is poor in world" (Heidegger 1995: 192; italics by Heidegger). On the other hand, to support his position Heidegger utilizes Uexküll's environmental relativism, taking the normal

species-specificity of environments to the point it becomes (in a completely different way than Uexküll intended) a separation factor between animal and man.

> It is true that amongst the biologists Uexküll is the one who has repeatedly pointed out with the greatest emphasis that what the animal stands in relation to is given for it in a different way than it is for the human being. Yet this is precisely the place where the decisive problem lies concealed [...] For it is *not* simply a question of a *qualitative otherness* of the animal world as compared to the human world, and especially not a question of quantitative distinctions in range, depth, and breadth [...] but rather of whether the animal can apprehend something *as* something, something *as* a being, at all. If it cannot, then the animal is separated from man by an abyss (Heidegger 1995: 263–264; italics by Heidegger).

Therefore the difference in animals compared to humans would be the fact that the latter have the possibility to refer to something *as something*. Already stated by Cassirer with his theory of the non-thingness of perception – and also Heidegger refers to the environmental objects of man with the term "*present-at-hand* thing [*vorhandenes* Ding]" (Heidegger 1995: 255; italics by Heidegger) –, a very different theoretical foundation is bestowed on this connection, stating that this "something" that the animal cannot perceive is the being as such. So from this point on, the question shifts from the perceptive and cognitive level to the ontological one: in essence, the animal's relationship is blocked from "what is present at hand in its *being* present at hand, as a *being"* (Heidegger 1995: 248; italics by Heidegger), and this also affects his self-understanding – "*The animal as such does not stand within a manifestness of beings. Neither its so-called environment nor the animal itself are manifest as beings*" (Heidegger 1995: 248; italics by Heidegger).

To better define the animal's "*so-called environment"* and differentiate it from the world (to which only man has access), Heidegger develops the concept of *disinhibiting ring* (*Enthemmungsring*), where the derivation of the Uexküllian notion of functional circle is evident (and explicitly recognized by the German philosopher). In a theoretical frame where the being as such is not accessible to the animal, but where it is obvious at the same time that, in its behavior, it refers to other than itself, Heidegger chooses to characterize this "other than itself" basing not on what it is but on its function: disinhibition. With disinhibition, Heidegger means the activation of instinctive motoric sequences, a biological dynamic that he sees as the necessary behavioral side of a being that cannot spontaneously have access to the world:

> That which disinhibits and releases the inhibitedness of the instinctual drive, that which allows the instinctual activity to respond to the disinhibition, and thus allows the animal to move within certain instinctual drives, must always in accordance with its essence withdraw itself. It is *nothing enduring* that could *stand over against the animal as a possible object* – whether as something changed or unchanged [in the process]. The self-withdrawal of that which disinhibits corresponds to the essential inability to attend to it which is involved in behaviour, that is, the *inability to attend* that which disinhibits as something objectively present at hand (Heidegger 1995: 255–256; italics by Heidegger).

Heidegger's linguistic virtuosity here is noteworthy. The otherness that the animal relates to, and that allows it to deploy its behavioral potential, is qualified as *die Enthemmung*, *das Enthemmende* or even *was enthemmt*, expressions that

are each translated into "the disinhibition", "the disinhibited" and "that which disinhibits". That which disinhibits does not have to be a being, yet – as we do observe its effects on animals – it must be something. From a grammatical point of view (and here the German language is helpful), a substantive is simply created from a verb: from *enthemmen*, the fact of dis-inhibiting – the *function* – we get *das Enthemmende*, the disinhibiting, that which disinhibits.

Heidegger resorts to this terminology in order to avoid the use of the word *stimulus* as much as possible, and this way to give the impression that the disinhibiting ring that surrounds the animal is of a perceptive nature – which actually would put Heidegger in the second perspective mentioned above: the qualitative investigation on the categorical-perceptive structures of the animal. In fact, in biology and ethology, it is completely normal to acknowledge the disinhibiting action of the perceived stimuli (a sound or sequence of sounds, a combination of colors, etc.) and it is not necessary that scholars – unaware victims of bad metaphysics – think about the stimuli in terms of things, beings or representations of beings. The stimuli are, above all, perceptive elements. Additionally, contemporary ethology has acknowledged that the deactivation of instinctive sequences is not the only form of animal behavior, as it would seem from the Heideggerian approach: the world of higher animals (that Heidegger almost completely overlooks, preferring examples taken from the world of insects and reptiles) is full of examples of apprehended and explorative behavior. This limit of Heidegger's interpretation is probably due to Cassirer's mediation on one hand, and on the other, to the fact that in 1929–1930, the Uexküllian works that are the most attentive to the environment of higher animals had not been published yet.

The centrality that Heidegger attributes to the concept of disinhibiting ring pictures animality as a pre-determined and blind field of action that does not include any spontaneity and where the animal's cognitive relationship with the world limits itself to a sort of obscured reactivity. In order to sustain this theory, the philosopher goes back to the Uexküllian image of environment as a tunnel, exaggerating it[23]: "throughout the course of its life the animal is confined to its environmental world, immured as it were within a fixed sphere that is incapable of further expansion or contraction" (Heidegger 1995: 198). According to Heidegger, the environment of a poor-in-world organism, where beings are inaccessible, is thus characterized as a closed circle of triggering factors: more than acting, the animals "are absorbed" by a behavior and brought to its end where another "driven behavior" is triggered, and so on. Heidegger uses the term "captivation" [*Benommenheit*] for this condition:

[23]The expression *Umwelttunnel* is in the second edition of *Theoretische Biologie*: "If we picture the environment of an animal at a certain time as a circle, we can add to it every following moment as a new environmental circle; this way we obtain a tube, which corresponds to the length of the animal's life. [. . .] Therefore, the life [of animals] resembles an environmental tunnel of which both ends are closed" (von Uexküll 1928: 70). The metaphor does not take on any negative meaning in Uexküll.

> The *captivation* of the animal therefore signifies, in the first place, essentially *having every apprehending of something as something withheld from it*. And furthermore: in having this withheld from it, the animal is precisely *taken by things* [. . .]. This captivation makes possible and prescribes an appropriate leeway for its behaviour, i.e., a purely instinctual redirecting of the animal's driven activity in accordance with certain instincts in each case (Heidegger 1995: 198; italics by Heidegger).

Moving to a general critical evaluation, firstly, the Heideggerian argument is based on the idea that the vital organization of animals is not an autonomous sphere, but depends on the ontological essence of the animal as such, on the so-called "animality" (that ultimately coincides with the poverty in world). From the biological point of view, this definition of the problem presents some serious shortcomings. For example, it does not explain why animality is not expressed in only one ontological category (the animal) – as instead has happened with the having-world, expressed only in the human being – but has been embodied in the multi-formed variety of the existing species. In fact, rather than animal species, Heidegger discusses the animal's *essential character* – an "*essential character of the being of living things*, and one that precisely finds expression in what we have come to know as the fundamental structure of animality: captivation, the animal's struggle with the its disinhibiting ring" (Heidegger 1995: 265–266; italics by Heidegger). Like Uexküll, who does not explains the origin of the diversity of building-plans, Heidegger does not explain how the current diversity of disinhibiting rings came about, which is the basis for what is typically seen as the diversity of biological species. He limits himself to stating that in this new perspective "it is not only the reliability and the import of the celebrated and notorious concept of "development" which has become questionable, but we now have to confront quite new phenomena, [. . .] which have set the problem of the *particular kind of occurrence* [*Geschehenscharakter*] involved in the organization of the organism upon a more comprehensive and more profoundly conceived basis" (Heidegger 1995: 266; italics by Heidegger).

Behind this veiled statement that species do not evolve but "occur", we begin to see the Heideggerian battle against modern Western science (of which Darwinism is a perfect example, according to Heidegger) and its inadequateness in recognizing the authentic ontological dimension of the beings that it studies. If the tone used by Heidegger in the anti-Darwinian debate reminds us of Uexküll's criticism, the opposition of the latter to the theory of natural selection is ultimately linked to the bold defence of the scientific validity of a category of explicative principles (the teleological and immaterial one), while Heidegger's criticism comes from a resolute opposition to Western science in general.[24]

[24]Heidegger moves the accusation to biology and zoology (with the exclusion of Uexküll and, significantly, Driesch) of not knowing how to see that "life is *not simply organism* but is *just as essentially process*" (Heidegger 1995: 265; italics by Heidegger) and almost completely disregarding the "character of occurrence" of biological species. This accusation stands only if the Darwinian idea of the processuality of phylogeny is overlooked; in fact, the theory of evolution by natural selection decisively goes beyond the level of the single organism, to the point of connecting

Heidegger's "metaphysicalizing" approach also translates into the clear refusal to place the relationship between animal and environment in a perceptive or cognitive light and to use notions as stimuli or categories. If the relationship of one animal with another was based on the perception and processing of the stimuli triggering behavioral modes, the disinhibiting ring would simply coincide with the perceptive organization – which risks lessening the importance of the presumed poverty in world. Above all, if the problem of the ontic or non-ontic nature of the "other" that surrounds the animal became a problem of categorizing the perceived (such as for Cassirer and Langer), then nothing would stop the relationship between man and world from being explained in the same terms. The explanation of the fact that "*only we* [men] are capable of experiences and having manifest [something] *as being"* (Heidegger 1995: 269; italics by Heidegger) would therefore be traced back to the presence of various perceived and cognitive structures, that were remolded by the use of language and that drew immense possibilities for the stabilization and further elaboration of the perceived. In other words, the qualitative difference between man and animal would be investigated as a different evolutionary line undertaken by that particular animal, man, who linguistically remodelled his mind, perception and behavior and inserted centers of stability as well as abstract and comprehensive categories into the fluid animal environment.

In conclusion, the basic limit to Heidegger's approach to the study of animal life (clearly visible in his reading of Uexküll) is the fact that he takes cues from the poverty in world: this way the animal is studied beginning from what differentiates it from man and not from what is peculiar to it. It is significant that, toward the end of his discussion about animality, Heidegger feels the need to address this possible objection: "it is only from the human perspective that the animal is poor with respect to world, yet an animal being in itself is not a deprivation of world. [. . .] In this case the thesis concerning the animal's poverty in world is not an interpretation which remains true to the proper essence of animality, but merely a comparative illustration" (Heidegger 1995: 270–271). If this is true, the Heideggerian discussion risks not saying anything about the animal. Even his most important element, the concept of disinhibiting ring, in fact, is based on the idea that beings as such are not accessible to the animal because the "manifestness of beings" is peculiar to man's world. The problem stems from using the category of world for determining

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every organism and every living species with the first cells that appeared on the earth. Expressed concisely: Heidegger attributes to Darwinism the limit of not knowing how to overcome the level of the single organism – the ontogenetic level – in favor of a wider vision of the event of animality. Identifying the ontogenetic level with the ontic level, he makes this hypotetical Darwinian limit a meta-physical limit: Darwinism would not be able to lead to an ontological consideration of the animal, but it would stay stuck on the level in which the animal is a mere being, something detached from the horizon of its occurring. However, if we conceptually distinguish the ontogenetic level from the ontic one, Darwinism is not at all blocked on the level of the single being. On the contrary, the latter receives full meaning through the overcoming of that level, but in a direction that is not that of the ontological occurrence, but that of phylogenetic differentiation of the species (which is precisely a processual and dynamic theory of the living).

animality, a category that is definitely not essential in order to study the relationship between animal and environment, which can be studied regardless of the fact that *Umwelt* is not fully *Welt.*

Finally, as Bassanese observes, Heidegger's conception of animality is part of a complex and not always transparent strategy aimed at linking the animals' poverty in world to the inauthentic existential modalities of man. After taking into consideration the Heideggerian passages about animality contained in the works released after the 1929–1930 course, the author states that:

> The affinities suggested by Heidegger between animal ensnarement and the so to speak inauthentic, or inappropriate, life of contemporary man, cannot be ignored. [...] This distance from one's own self is similar to that of animals, which live constantly in 'fear' of suppression, which cannot perceive themselves and are therefore radically closed toward the human experience of care. What is in man a flight from himself, and so an 'improper' way of life next to another more essential one, constitutes the indissoluble nature of animals. Not only are they closed to their own selves in their unawareness, but they are also limited to this obstruction, unlike man who can free himself, taking charge and deciding to take responsibility for his own set situation placed in the world (Bassanese 2004: 295–296).

If it explains the real motivations of Heidegger's interest in animal behavior, his intent to bring animality and inauthentic existence closer together risks, once highlighted, widening the gap that separates the German philosopher from Uexküll. As we have seen above in the comment on the Gehlenian concept of modernity, Uexküll's opinion is that man's natural condition is to be placed in a symbolic environment that, even though it is more varied and richer than animal environments, is not radically or "essentially" different from them. The breach in the natural relationship of the individual with its environment – which on a socio-political level coincides with the end of a class society and with democracy, according to Uexküll – neither prepares nor makes a stronger existential authenticity possible; it only leads to the disorder due to the disturbance of the planned order of the world.

7.2.2 Ebner

Best known for his contribution to the dialogical philosophy of the twentieth century represented in his *Pneumatologische Fragmente* (Ebner 1963), the Austrian philosopher Ferdinand Ebner (1882–1931) expresses interest in Uexküll in a lesser-known text of the years 1913–14, *Ethik und Leben* [*Ethics and Life*] (Ebner 2013). In this work, dating back to the first phase of Ebnerian production prior to the dialogical shift, Ebner outlines a philosophy of life and an anthropological philosophy with anti-mechanical and actualistic basis. In *Ethik und Leben*, life is seen as a unitary but not substantial process, that organizes and permeates the material sphere but that is not reducible to the physical-chemical processes of the inorganic sphere. As an ordering and organizational principle that goes ahead amongst material chaos, the Ebnerian concept of life is close to Bergson's *élan vital* and full of Nietzschian references; however Ebner's position is more complex and can be described as

an attempt at thinking about life itself, almost apart from of its relationship with matter. In *Ethik und Leben,* life is pure act, but it is also soul. It is a soul that "should not be thought as something substantial [. . .], independently of the fact that this something substantial is intended in a more spiritual or more materialistic way" (Ebner 2013: 66). The living processuality, the soul and the pure act of life is "intersected [*durchkreuzt*] by anorganical processes" (Ebner 2013: 40) that sometimes seem to represent a disturbance, or at least resistance, that life has to ward off.

Ebner's reception of Uexküll occurs within these theoretical coordinates; this reception is based on the reading of several articles the Estonian biologist published in *Die neue Rundschau* at the beginning of the 1910s (*Das Subjekt als Träger des Lebens* [*The Subject as a Carrier of Life*] (von Uexküll 1912a), *Wie gestaltet das Leben ein Subjekt* [*How a Subject Shapes Life*] (von Uexküll 1912b) and *Wirkungen und Gegenwirkungen im Subjekt* [*Actions and Counter-Actions in the Subject*]) (von Uexküll 1912c). From the analysis of *Ethik und Leben,* one can deduce with good probability that the most important article for the Ebnerian reading of Uexküll's thinking is *Das Subjekt als Träger des Lebens.* Even though these articles are mostly focusing on the question of the biological subject, they deal with all central issues of the Uexküllian conception and, therefore, provide a good introduction to it.

The first convergence points between Uexküll and Ebner's philosophy of life are found in the claim of the irreducibility of life to physical-chemical processes and in the charge of theoretical insufficiency moved to Darwinist materialism. Ebner writes:

> Quite rightly, the biologist Jakob von Uexküll blames Darwinism for having annihilated biology for half a century at least. Ultimately, if the starting point is the mechanical events of matter, it will never be possible to explain the creation of an organism, of a "purposeful system" closed within itself, of a world with a sense, a meaning (Ebner 2013: 23).

As the quote shows, the fear that biology can lose its teleological inspiration, and therefore (in his opinion) every ability to understand the living, motivates Ebner's anti-mechanism and anti-Darwinism. Ebner finds a valid ally in Uexküll on this point, too, since the Estonian biologist values the principle of conformity to a plan in every sector of biology – i.e. not only in the embryological, anatomical and physiological fields, but also in the "ecological" sphere of the relationship between animal and external reality: "Uexküll sees in biology in general the theory of the finality of nature. [. . .] He detects a double finality. "On one hand, the organism is teleologically organized in itself; on the other hand, it is teleologically part of its environment"" (Ebner 2013: 25).

Up to this point, Ebner follows Uexküll's thinking exactly. However, he departs from it on the question about what is ultimately responsible for the integration of the organism into the environment:

> In the harmony devoid of dissonances between the individual's organism and its environment, in this compatibility between the two – which is ultimately "transcendent", and which for this reason never unveils itself to an objective observation – life becomes real, it appears in the surrounding world of the material element (Ebner 2013: 26).

According to Uexküll, if it is the organism itself that (thanks to its building-plan) places itself organically in the species-specific environment, according to Ebner, it is life – meant metaphysically as an autonomous force – that establishes such a harmony. Moreover, for Ebner, there is a tendency, which is more Nietzschian than Uexküllian to see the single organism as a temporary instrument that is used in life to affirm itself in the struggle against matter, its antagonistic universal principle. Moreover, in the quote taken into consideration Ebner uses the term "transcendent", which does not belong to the Uexküllian vocabulary, to characterize the relationship between organism and environment.

These signs of a distance from the Uexküllian "letter" are closely linked to the disregard of the Kantian roots in Uexküll, as we have already seen in other interpreters. Yet, these roots are evident in *Der Subjekt als Träger des Lebens*, where Uexküll writes, for example:

> "What elements do the objects in [animals'] subjective worlds consist of, and what is the modality of this composition?" – the biologist will ask. The answer to this question was not given by naturalistic scientists, but by philosophers. Especially Kant's genius showed the way here. We are all aware of the fact that each one of the object's qualities is also one of our sensations (von Uexküll 1912a: 107).

Only by ignoring this and other central passages for understanding the Uexküllian concept of biological subject, can Ebner interpret the *transcendental* relationship between animal and environment, as a relationship of the same two poles with a third *transcendent* force, life, that this way becomes the only real subject of organic processes. In doing so, paradoxically, in *Ethik und Leben* Ebner risks obtaining the same negative result that he reproaches to Darwinism: that of depriving the single organism (or the single species) from all spontaneous organizing power. Certainly, Darwinism – or rather, its mechanical interpretation that was wide-spread at the beginning of the twentieth century – uses this shift in favor of the materially intended environment, while Ebner does it in favor of "life", but from the point of view of the organism, the result is the same: it is reduced to a temporary apparition of more powerful hidden forces. In fact, Ebner's central idea is that "self-actualizing" of life in forms that are continually more complex culminates in the emergence of man, and human conscience in particular – and even this concept is completely unrelated to the Uexküllian theoretical context.

In reference to this, we see the last quote from *Ethik und Leben*:

> Is not the living something that, in a way, has always a subjective existence, something that is spontaneously and immediately, as existing form, interested in its own existence, in life [...]? Biologists themselves recognize the "subject" as "carrier of life". "Out of the subject there is no life whatsoever" (Jakob von Uexküll). Next to "objective" biology, therefore, [...] there has to be another doctrine of life – be it called subjective or, if one wishes, introspective – which attempts to find out how the living give themselves life [...] and which ultimately leads to ethics (Ebner 2013: 12–13).

The two authors' view of the statement that the subject is "a carrier of life" is therefore very different: Uexküll stresses the role of the subject as a transcendental autonomous entity, equipped with its own plan that determines its entire experience, whereas Ebner places importance on life meant as a metaphysical subject, which

revives itself in particular subjects according to the logic of a progressive liberation from material constraints. It is not surprising that, according to the Austrian philosopher, these progressive actualizations are due to a desire for knowledge and relationships that life orients firstly to itself, and that is realized completely in the freedom of man's inner life. This metaphysicalization and ethicalization of the living subject, however, has Ebner irrevocably diverge from Uexküll, who not only considers with Kantian diffidence the systematic appeal to ultimately empirically inaccessible forces, and prefers the scientific reconstruction of environments starting from observable behavior rather than introspection. This is also true in the case of man, as it could be seen, however, only in *A Foray into the Worlds of Animals and Humans*, which Ebner could not have known about.

7.2.3 Lacan

Uexküll's works and ideas significantly enters into the French philosophical thought of the 1940s and 1950s thanks mostly to the mediation of Georges Canguilhem and Maurice Merleau-Ponty. However, already at the beginning of the 1930s, a positive evaluation of the concept of *Umwelt* was provided by Jacques Lacan in his doctoral thesis, *De la psychose paranoïaque dans ses rapports avec la personnalité* [*Paranoid Psychosis and its Relations to Personality*], where Lacan tries to include into the definition of mental phenomenon (also and above all of pathological nature) the analysis of the conditions of its appearance and of the context of its formation. From this derives not only a greater attention to the global personality of the subject, in the particular case of a paranoid subject, but also the conviction that personality is the center of a network of (material and symbolic) external relationships that determine it in equally essential measure as the intra-organic and intra-psychic dynamics. As Ogilvie states, in *De la psychose paranoïaque dans ses rapports avec la personnalité*

> the [traditional] thinking on substances that are part of a more general ontology (soul, body, union of the two, hierarchy . . .) is countered by the concrete perception of living beings (including man) in a specific environment, i.e. as creating around each being a network of relationships which are like the continuation of their organs and form *their own* reality, which does not exactly coincide with the objective reality (Ogilvie 1987: 61; italics by Ogilvie).

The study and cure of paranoiac symptoms will therefore be situated within a concrete analysis of the patient's personality, which includes his/her history, family and social relationships. According to Lacan, this is the only way to see the full range of effects of the illness itself, which emerges as an "autonomous disease that manipulates personality" (Lacan 1975: 324).

Lacan's reference to Uexküll happens in this theoretical context, which is highly innovative if compared to the psychiatry of the time. After defining personality as

"the system formed by an individual and his environment" (Lacan 1975: 317), Lacan notes:

> One of the most important biological currents valued the concept of environment specific to a certain living being; environment, defined by this doctrine, is so closely connected to the organization of the individual that it becomes, so to speak, part of it. See Jakob von Uexküll's major works (Lacan 1975: 317).[25]

Consistent with his own intentions and developing a theme that (though present) still remains marginal in the works of the Estonian biologist, Lacan almost exclusively concentrates on the social nature of man's *Umwelt:*

> As per our conception, here in accordance with Aristotle, human environment, in Uexküll's sense, would be *par excellence* the social human environment. Needless to mention how this conception goes against the doctrines, shattered anyway, of XVIIIth century individualistic anthropology and in particular against Rousseau's conception of *Social Contract* (Lacan 1975: 317).

It should be noted that the Lacanian use of Uexküll is based on the first edition of *Umwelt und Inennwelt der Tiere,* a text that (as we have seen) concentrates on lower animals and talks relatively little about man; this is to say that Lacan is able to apprehend the specificity of the human environment from a limited text base. However, his intuition about the exportability of the concept of Umwelt into a social-psychological research field is indirectly confirmed in Uexküll's socio-political work from *Volk und Staat* to *Staatsbiologie*, where we can find both the refusal of giving supremacy to the individual over the social environment (a refusal that, given the author's political beliefs, goes to the point of denying any value even in democracy, seen as excessively individualistic) and the idea that a breach in the individual's social environment (for Uexküll, its class position) coincides with the appearance of personality disorders (see *above*, 31). Yet if it is possible to make this analogy, we should not disregard the important difference in intent that exists between the two authors: through the defense of traditional environments and identities, Uexküll wants to protect the state from the risk of dissolution inherent in modernity; differently, Lacan is interested in the study and treatment of the psychopathological effects that the destruction of social Umwelt or the loss of contact with it can have on personality (and, above all, in the formation of paranoid experiences that are themselves further deformations of the individual symbolic environment).

[25] As Chien observes, "Lacan situates Uexküll's theory in the context of psychoanalysis, claiming that doctrinal psychiatry has overly isolated psychotic patients within their brains while overlooking their living environments" (Chien 2006: 50). Besides investigating Lacan's direct reference to Uexküll, in his 1932 doctoral thesis Chien observes the permanence of Uexküllian influences that are also in later Lacanian work. In particular, the notions of Umwelt and *Innenwelt* will play an important role in the theory of *imago* (see Chien 2006: 51–59). For further evidence of Uexküll's imprint in Lacan's work, see Chiesa 2009: 92.

7.2.4 Canguilhem

Ever since its first appearances, even in French circles, Uexküll's name was associated with the idea of environment as Umwelt, a notion whose innovative capacity touches several disciplines. While Lacan uses it in psychoanalysis and, as we will see, Merleau-Ponty considers it an indispensable theoretical instrument in order to correct the mechanistic and Cartesian legacy that predominates behavioral studies, Georges Canguilhem makes it one of the strategic points in a large project that criticizes modern science. In all these cases, the idea of Umwelt is extended right from the beginning to the human experience, almost without making an issue out of the fact that this operation might risk cancelling the (eventual) qualitative difference of man compared to animal – whereas this point was essential for German philosophy and philosophical anthropology.

Canguilhem – who knows about Uexküll's texts *Umwelt und Innenwelt der Tiere* (first and second edition), *Theoretische Biologie* (second edition) and *A Foray into the Worlds of Animals and Humans* – deals with Uexküll's thinking mostly at a conference entitled *The Living and Its Milieu*, held in the academic year 1946–1947 at the *Collège philosophique* and later published in *Knowledge of Life* (Canguilhem 2008: 98–120). The theoretical context in which this confrontation occurs is a reconstruction of the history of the idea of environment that Canguilhem conducts very attentively both in its philosophic and scientific aspects. He situates the creation of the notion of environment toward the mid-eighteenth century when it is found in Newton and the *Encyclopédie* by d'Alembert and Diderot. In this first phase, the term displays a clearly mechanical meaning: the environment is above all a medium that surrounds a body and transmits movement. The concept's first entrance into the field of biology was due to Newton. In his optical theory, Newton foresees the existence of a medium, ether, which transmits the light impulse from its external source to the sensorial organs. For this to be possible, ether must exist in air, in the eye and also in the visual organs. Secondly, according to Canguilhem, the introduction of the concept of environment (still meant in a mechanical sense) in biology is due to Lamarck, who uses it to envisage the fluids (air, water) which an organism lives in; for him, they represent a first class of factors that structurally modify the organism itself (according to the well-known theory of evolutionary variations generated from external circumstances).

After establishing these initial theoretical coordinates, Canguilhem shows how the notion of environment goes from an initial mechanical use to one that is "authentically biological" (Canguilhem 2008: 102). This process of reinterpretation is notably anticipated by Compte, whom Canguilhem considers responsible for two important intuitions: the first is the holistic concept of the environment as the whole of the external circumstances (and no longer only or predominantly as a physical medium); the second is the idea that between environment and organism there is a reciprocity of influences, so that the environment system cannot modify the organism without, in turn, being modified by it. Without completely abandoning the mechanical use of the word, therefore, Compte begins to attribute larger spontaneity

to the organism in relationships with the environment. It is a tendency that continues with Darwin and his theory of the spontaneous variations of the organism – a kind of "proposals" that the organism addresses to the environment and that are approved or refused according to their adaptive value.

But in Canguilhem's opinion, the real turning point is another:

> Finally, the relation between organism and milieu is reversed in von Uexküll's studies of animal psychology and in Goldstein's studies in human pathology. [...] Von Uexküll and Goldstein agree on this fundamental point: to study a living being in experimentally constructed conditions is to make a milieu for it, to impose a milieu on it; yet it is characteristic of the living that it makes its milieu for itself, that it composes its milieu (Canguilhem 2008: 110–111).

Therefore, the relationship between animal and environment cannot be studied as a mechanical interaction, even if this relationship also involves a certain reciprocity. The fact that the presence of reciprocal action is not enough to render the peculiarity of the living is confirmed in the following passage.

> The relationship between the organism and the environment is the same as that between the parts and the whole of an organism. The individuality of the living does not stop at its ectodermic borders any more than it begins at the cell. The biological relationship between the being and its milieu is a functional relationship, and thereby a mobile one; its terms successively exchange roles. The cell is a milieu for intracellular elements; it itself lives in an interior milieu, which is sometimes on the scale of the organ and sometimes of the organism; the organism itself lives in a milieu that, in a certain fashion, is to the organism what the organism is to its components (Canguilhem 2008: 111).

Once the specific nature of the living being and its relationships with the surrounding context is understood, Canguilhem shows the Uexküllian distinction between Umwelt ("milieu of behavior"), *Umgebung* ("banal geographical environment") and *Welt* ("universe of science") (Canguilhem 2008: 111), finally concentrating on the concept of Umwelt. As with Lacan (and as we will see with Merleau-Ponty) Canguilhem also puts the idea of the subject as the core interest at the center of the analysis, seeing in it the source of a value-related field (the Umwelt):

> The milieu of behaviour proper to the living (Umwelt) is an ensemble of excitations, which have the value and signification of signals. To act on a living being, a physical excitation has not only to occur but also to be noticed. Consequently, insofar as the excitation acts on the living being, it presupposes the orientation of the living being's interest; the excitation comes not from the object but from the living. [...]. [The animal's] life rhythm orders the time of this Umwelt, just as it orders space. [...] The Umwelt of the animal is nothing other than a milieu centered in relation to the subject of vital values in which the living essentially consists (Canguilhem 2008: 111–112).

The hint at the ordering function of the organism as far as the environmental dimensions of space and time are concerned shows that Canguilhem is one of the few interpreters to acknowledge the Kantian roots of the Uexküllian thinking (that he nonetheless does not mention explicitly). However, Canguilhem does not understand the Kantian legacy in its radicality either; in fact, he too prevalently keeps to the interpretation according to which the formation of the environment is a

selective operation and not a constitutive one: "The Umwelt" – writes Canguilhem – "is thus an elective extraction from the *Umgebung*, the geographical environment" (Canguilhem 2008: 112).[26]

Even with this limit, Canguilhem's importance as a mediator of the Uexküllian thought in French philosophical circles is considerable. It is not only because of the attribution of spontaneity and autonomy to the organism, or only because of certain attention that is paid by him to the semiotic dimension of the Uexküllian Umwelt (that anticipates the more organic reflections by Merleau-Ponty and contemporary biosemiotics), but it is because he grasped the critical value of Uexküll's thinking regarding modern science. In fact, Canguilhem knows how to use the distinction mentioned above between Umwelt, *Umgebung* and *Welt* effectively as an instrument of opposition to the claim of absolute objectivity put forth by science. The author argues that while the relativity of the Umwelt of an animal (maybe lower) can be fairly easily noted, the notions of *Umgebung* and especially *Welt* (the universe as it appears to science) risk being given a misleading universality.[27] On this point, Canguilhem expresses himself strongly:

> As a living being, man does not escape from the general law of living beings. The milieu proper to man is the world of his perception – in other words, the field of his pragmatic experience; [it is] originally centered on him and by him. Yet man as scientist and bearer of knowledge constructs a universe of phenomena and laws that he holds to be an absolute universe. [...] Sensory data are disqualified, quantified, identified. [...] Measurement substitutes for appreciations, laws for habits, causality for hierarchy, and the objective for the subjective (Canguilhem 2008: 118–119).

According to Canguilhem, this abstracting operation is destined to fail. Far from actually reaching the level of absolute objectivity, it does not lead to anything except the construction of a specific environment that seems to enjoy a sort of illusory "privilege" (Canguilhem 2008: 119) compared to that of other living beings. Let us not forget indeed that even the scientific universe, like every other "environment", comes from a subject that is the center of a field of values and interests. Science is understood "as a sort of enterprise as adventurous as life" (Canguilhem 2008: 119), as the result of a special need of the living: knowledge. If it were not this way, the center of the scientific universe – man – would dissolve into it, and we would have to admit that science does not come from interests or needs of a living subject, but is a product that absolute reality created at the most *thanks to* man. This line of argument, which closely recalls the conclusive section of *A Foray into the Worlds of Animals and Humans*, definitely establishes an original and worthwhile contribution to the contemporary epistemological reflection.

[26] "What the milieu offers the living is a function of demand. It is for this reason that, within what appears to man as a single milieu, various living beings carve out their specific and singular milieus in incomparable ways" (Canguilhem 2008: 118).

[27] As Chien correctly observes, according to Canguilhem, the distinction between the Uexküllian concepts of *Welt* (as scientific universe) and Umwelt is ultimately conventional – however, keeping in mind that the creation of a convention always answers to life-related, subjective interests or needs (see Chien 2006: 62).

7.2.5 *Merleau-Ponty*[28]

Maurice Merleau-Ponty addresses Uexküll's theoretical biology in *Nature. Course Notes from the Collège de France*, a class held at the Collège de France in 1957–1958 (Merleau-Ponty 2003: 166–178). The comparison with Uexküll, which primarily focuses on the notion of environment and behavior, is part of the section of the course dedicated to trends in modern biology. This section was based, on one hand, on the previous year's lessons (where Merleau-Ponty deals with the main philosophical concepts of nature from Aristotle to Husserl and Whitehead), and on the other, on an in-depth analysis of the Cartesian concept of animal behavior. Judging by the space given to this subject matter in 1956–1957 and its reappearance the following year, it is safe to say that the problem of the Cartesian legacy inherent to modern biology takes on particular importance for Merleau-Ponty. In other words, the critical analysis of the Cartesian concept of the living being seems like an unavoidable step to understanding the developments of modern biology, according to the French phenomenologist.

This theoretical turning point is, moreover, entirely coherent with the reflections that Merleau-Ponty already develops in 1942 in *The Structure of Behavior* (Merleau-Ponty 1967), a work that, on the whole, can be defined as a criticism on the hidden Cartesianism in physiology and psychology in the first half of the twentieth century (especially in their behaviorist and Pavlovian versions). Yet overall, Merleau-Ponty means to criticize all the ethological and psychological theories that refuse a priori the problem of the sense of the animal's action and limit themselves to breaking up complex behaviors into chains of reflex actions. In these conceptions, the model of action is sought in an "elementary" process that associates a simple reaction to an isolated stimulus. Merleau-Ponty's general intent can therefore be expressed as such: does the organism that moves in the world react to stimuli, or does it encounter objects "invested with a certain value" (Merleau-Ponty 1967: 9)? And further: is the environment to be considered as a set of stimuli or as a field of meaning? If in *Phenomenology of Perception* Merleau-Ponty tries to analyze the phenomena connected to the establishment of that field of meaning in human conscience (better yet: *as* human conscience), the classes at the *Collège de France* seem to directly tie back to the subject matter from the 1942 text. In the 1957–1958 class on nature, in particular, Merleau-Ponty recalls and elaborates the critique to the concept of stimulus and proposes a concept of environment that is phenomenologically more appropriate.

It is within these coordinates that Merleau-Ponty aligns with Uexküll, of which he reads the first edition of *Umwelt und Innenwelt der Tiere* and *A Foray into the Worlds of Animals and Humans* and with whom he immediately feels a strong closeness. The Uexküllian idea of Umwelt is also Merleau-Ponty's starting point:

[28]This section is a shortened version of Brentari 2010.

> [Uexküll's] Umwelt marks the difference between the world such as it exists in itself, and the world as the world of a living being. It is an intermediary reality between the world such as it exists for an absolute observer and a purely subjective domain. It is the aspect of the world in itself to which the animal addresses itself, which exists for the behavior of the animal, but not necessarily for its consciousness (Merleau-Ponty 2003: 166).

Merleau-Ponty observes that the lacking existence "for the consciousness" does not really implicate that the Uexküllian concept of environment-for-behavior should be interpreted in a behavioral or mechanical light. On the contrary, it means to spread the field of meaningful action or, better, *the natural phenomenon of meaning* to a level of the living in which a human's beings "clear and distinct" consciousness is not present. Taking seriously into consideration the sense of the Uexküllian distinction between perceptive world and operative world, Merleau-Ponty observes that the orientation toward a species-specific environment "begins well before the invention of consciousness",[29] even with lower animals. That orientation "can be read as the direction of a behavior", since

> we have stimulations that act, not by simple physical presence, but insofar as an organism is disposed to receive them and treat them as signals. Consciousness is only one of the varied forms of behavior; it must not be defined from within, from its own point of view, but such as we grasp it across the bodies of others [including animals]; not as a centrifugal form, but as a closed world where external stimulations appear to it as outside of it. Consciousness must appear as institution, as a type of behavior (Merleau-Ponty 2003: 166).

In this formulation, consciousness as emerges in human beings is only one of many possible behavior modes. It is an orientation *toward* and *in* that sector of the world that establishes the species-specific environment. This thesis brings to life the stimulating challenge to try and understand the perceptive environment of animals that do not have a human-like consciousness: the absence of a consciousness does not imply the absence of sensitivity, and the absence of reasoning does not mean that the function of sensitivity has to be reduced to the transmission of mechanical stimuli (as Descartes believes). But how can a human researcher approach a mode of experience that is fundamentally different from the species that it belongs to? To try to describe "from inside" the environment of animals, their subjective environmental experience, Merleau-Ponty uses the metaphor of *melody of stimuli,* which can often be found in Uexküll's work (see *above*, 161).[30] In the 1957–1958 course, Merleau-Ponty observers that even for lower animals, according to Uexküll, "there is everywhere the unfurling of an Umwelt", and he asks himself:

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[29] *Ibidem*.

[30] In addition to Uexküll, this metaphor is found in scholars such as Volkelt ("What is saved in the memory of a carrier pigeon or of a migrating bird is not, as is usually assumed, a massive amount of isolated representations, but rather a sequence of complex qualities, not unlike a melody [*melodieartig*], which gradually unwind as a result of sensory impulses" (Volkelt 1912: 126) and Langer (animal behaviors are "acts formed in impulses and guided by the melody-like passage and growth of sensible and emotive feeling, to consummation or failure" (Langer 1972: 101)). Not less important, this metaphor is also found in Lorenz; see Lorenz 1977: 201.

> What is unfurled, and from what? [Uexküll sees] the unfurling of an Umwelt as a melody that is singing itself [. . .]. This is a comparison full of meaning. When we invent a melody, the melody sings in us much more than we sing it; it goes down the throat of the singer, as Proust says. Just as the painter is struck by a painting which is not there, the body is suspended in what it sings: the melody is incarnated and finds in the body a type of servant. The melody gives us a particular consciousness of type. We think naturally that the past secretes the future ahead of it. But this notion of time is refuted by the melody. At the moment when the melody begins, the last note is there, in its own manner. In a melody, a reciprocal influence between the first and the last note takes place, and we have to say that the first note is possible only because of the last, and vice versa. It is in this way that things happen in the construction of a living being. There is no priority of cause over effect. [. . .] As Proust says, melody is a Platonic idea that we cannot see separately. It is impossible to distinguish the means and the end, the essence and the existence in it. From a center of physical matter surges an ensemble of principles of discernment at a given moment, which means that in this region of the world, there will be a vital event (Merleau-Ponty 2003: 173–174).

After finding it in Uexküll, Merleau-Ponty elaborates the metaphor of melody, linking it to two truly phenomenological problems: the time dimension of the living and the type of causality that it is appropriate to apply to behavioral studies. The intent to oppose a typical feature of modern science is clearly visible here, i.e. its strict adherence to a rigidly consequential causal relationship; instead, Merleau-Ponty advances the idea that it is necessary to substitute, at least in biology, a dualistic concept of cause with a multi-factorial one where the action of the causes on the organism is mediated by a situation which has a global meaning.[31] This is the aim of the criticism on behaviorism developed in 1942, and of the appeal to Uexküll for qualifying the environment as a field of meaning with an open "melodic" structure.

Merleau-Ponty's vision of the environment as a field of sense or a "relationship of meaning" has another implication. As we highlighted before, it goes against

[31]It is interesting to note how Merleau-Ponty seems to focus on the aspects of Uexküll's thinking that are less acceptable by modern science – firstly the hypothesis of inter-dependence links between the future and past, that modern science rejected when, in the seventeenth century, it favored material causes over final causes. What Merleau-Ponty appreciates in Uexküll is, therefore, a direct consequence of his vitalist, or at least teleological, approach; as for the rest, the French philosopher already observed in 1942: "But problems of 'order' [or 'sense'] can be rejected as anthropomorphic. If Gestalt theory is not 'vitalist', it would nevertheless introduce anthropomorphism and finality into physics as well into physiology, by the very fact that it projects human norms into phenomena and supposed 'directed' or 'ordered' processes. It is clearly evident that, in speaking of a response 'adapted' to the stimulus or of a succession of 'coherent' movements, we are expressing relationships conceived by our mind, a comparison made by the mind between the 'meaning' of the stimulus and that of the reaction, between the 'total meaning' of the response and the partial movements which compose it. These relationships of meaning by which we define order result precisely from our own organization. Thus they have no need to be explained by distinct principles" (Merleau-Ponty 1967: 49). Merleau-Ponty proposes this kind of finalism – that can be defined as "weak" compared to the vitalist and neovitalist ones since it does not presume the real existence of entelechial entities, but it stops at the phenomenological-empirical level – as a correction of modern science, this way placing himself in a critical line which was supported also by Canguilhem (see *above*, 211).

the mechanical and behavioral concept of a passive organism that limits itself to reacting to stimuli coming from the exterior. In Merleau-Ponty's opinion, the organism is instead willing to treat the stimuli that it receives as signals and it is therefore an interpreting subject, that is oriented in an articulated and flexible way to the possible meanings of its own environment. Despite the different approaches, Merleau-Ponty's interpretation of the Uexküllian notion of environment goes in the same direction as contemporary biosemiotics (see *below*, 225).[32]

This vision of the organism implies that the animal is able to respond in a diversified way when presented with the same stimulus or object. Referring to one of Uexküll's example, but pushing further its implications, Merleau-Ponty observes:

> The crab uses the same object (the sea anemone) to different ends: sometimes for camouflaging its shell and protecting itself thus against fish, sometimes for feeding itself, sometimes, if we take away its shell, for replacing it. In other words, there is a beginning of culture. The architecture of symbols that the animals bring from its side thus defines within Nature a species of preculture. [With the increase in proximity to man] the Umwelt is less and less oriented towards a goal and more and more interpretation of symbols. But there is not a break between the planned animal, the animal that plans, and the animal without plan (Merleau-Ponty 2003: 176).

The animal without plan, as emerges in the author's later reflections, is none other than man. It is not possible to elaborate on this point here, but it should be remembered that, according to Merleau-Ponty, the larger opening of man's Umwelt is ultimately due to the particular nature of human consciousness, "that we can call a 'transcendental field', a field that valorizes the ensemble of vital fields" (Merleau-Ponty 2003: 178). However, more than emphasizing man's uniqueness, the pages that Merleau-Ponty dedicates to Uexküll in the 1957–1958 course aim to highlight the deep unity of the organisms provided with an environment, including human beings, a unity based on the notion of meaning, oriented action and, lastly, interpreting perception.

7.2.6 Deleuze and Guattari

In the complex and articulate "topography of the multiple" described in *A Thousand Plateaus*, released in 1980, the French philosophers Gilles Deleuze and Félix Guattari describe a stratified but not hierarchical ontology, full of internal tensions and fracture lines, where animal world and human history, physiology and mechanics interact and blend in the attempt at portraying the "schizophrenic" character of capitalistic contemporaneity (Deleuze and Guattari 2004). From the constructivist effort of the authors, transversal concepts emerge which are able to

[32]Unlike Sebeok, however, Merleau-Ponty does not seem to believe that the Kantian roots of the Uexküllian thought contributed positively to his environmental theory (as reflected by the scarce references by the French philosopher to the problem of the Kantian legacy in Uexküll; see Merleau-Ponty 2003: 177–178).

describe phenomena belonging to very different spheres of reality; some of the most significant examples are the molar/molecular, rhizome/tree and territorialization/deterritorialization contrapositions.

The inspiring focal point of this purposefully asystematic text can be found in the desire to describe a reality that is stratified, but at the same time dynamic and de-hierarchized. The authors start off with a (traditional, they admit) distinction between chemical-physical, organic and anthropomorphic layer, to continue with the description of the relationship between the layers. Those relationships are characterized by strong mobility. One layer can act as an underlayer for another, without ever assuming predefined relationships of subordination or superordination, and in every layer different dimensions open up (such as environments and territories in the organic layer). In addition, and this might be the newest feature, in the stratified reality described in *A Thousand Plateaus,* being and meaning, ontology and semantics intertwine to the point of blurring together: "Each stratum, or articulation, consists of coded milieus and formed substances. *Forms and substances, codes and milieus* are not really distinct" (Deleuze and Guattari 2004: 553; italics by Deleuze and Guattari).

In *A Thousand Plateaus,* the main reference to Uexküll is in the discussion about the organic layer of reality, among whose supporting structures we find the organization in *associated milieus*. According to Deleuze and Guattari, the associated milieu is a biological context that can be found around organisms of a higher level than plants; if the plant's organic situation is determined by the mere assimilation of nutritive substances, an associated milieu allows for the organization of metabolic energy, for perception and reactive capacity. As the authors put it, "the development of the associated milieus culminates in the animal worlds described by von Uexküll, with all their active, perceptive, and energetic characteristics" (Deleuze and Guattari 2004: 57; the example given by Deleuze and Guattari is the Umwelt of the tick). The next step is to grasp the relationship of the environment with the production of organic forms: "An animal milieu, such as the spider web, is no less "morphogenetic" than the form of the organism" – Deleuze and Guattari write – "Since the form depends on an autonomous code, it can only be constituted in an associated milieu that interlaces active, perceptive, and energetic characteristics in a complex fashion, in conformity with the code's requirements" (Deleuze and Guattari 2004: 58).

The originality of Deleuze and Guattari's interpretation lies in the identification, clearer as by the interpreters seen up till now, of the semiotic component of the notion of environment, which indeed does not so much focus on the concept of symbol as much as on that of code. While Canguilhem and Merleau-Ponty, who also move in the same direction, stay faithful to the schema of a subject that symbolically interprets reality (which is not symbolic in itself), Deleuze and Guattari's "decentralized" approach allows us to see as codes both the physical subject and the environment that it deploys. This way, the relationships between the organisms appear as a stream of meanings that determine each other and flow from the codes themselves.

Therefore, it is not an accident if Deleuze and Guattari demonstrate that they seriously consider not only *A Foray into the Worlds of Animals and Humans*, but also a book like *A Theory of Meaning*, which is as underestimated by philosophers as it is appreciated by semioticians (as we will see in paragraph 7.4). To give an example of the phenomenon of transcoding – i.e. the institution of an "intermixing" level that mediates between two layers and that is also called "passage between milieus" (Deleuze and Guattari 2004: 553) – the authors actually refer to the Uexküllian idea of the relationship between species as a relationship between musical scores that intertwine. Deleuze and Guattari reinterpret this idea in terms of an interlinking of codes:

> One case of transcoding is particularly important: when a code is not content to take or receive components that are coded differently, and instead takes or receives fragments of a different code as such. The first case pertains to the leaf-water relation, the second to the spider-fly relation. It has often been noted that the spider web implies that there are sequences of the fly's own code in the spider's code; it is as though the spider had a fly in its head, a fly 'motif', a fly "refrain". [. . .] Jakob von Uexküll has elaborated an admirable theory of transcodings. He sees the components as melodies in counterpoint, each of which serves as a motif for another: Nature as music. Whenever there is transcoding, we can be sure that there is not a simple addition, but the constitution of a new plane, as a surplus value (Deleuze and Guattari 2004: 346).

This concept, according to which the relationships between species (and also, in the phenomenon of territoriality, between individuals of the same species) would be the counter-puntistic relationships between different "themes" or "patterns", accompanies the analyses that Deleuze and Guattari dedicate to the organic layer. Those analyses show the environments as complex and delicate "*melodic landscapes"* (Deleuze and Guattari 2004: 351; italics by the authors) that place themselves among the fundamental components – even if purely elementary, being products of given codes – of the ontology of the multiple elaborated by the authors. Nevertheless, as Pieron observes, while Uexküll supplies Deleuze and Guattari with valid "resources for a "vitalist" ontology" (Pieron 2010: 92) and for overcoming the traditional separation between man and animal, Uexküll is quite far from the constructivist idea of the mobility and productivity of layers. Uexküll's world is dominated by the harmonizing action of nature intended as superordinate factor, while Deleuze and Guattari's pluralist ontology is permeated by a becoming, which, despite pivoting on codes and paths of recognizable concatenations, is fundamentally anti-hierarchical and contingent.

7.3 The Relationship Between Lorenz and Uexküll

In order to analyze the complex connections between Konrad Lorenz's work and Uexküll's thinking, it is opportune to divide the works in which Lorenz explicitely mentions the Estonian biologist into three groups and deal with each one separately. The first group includes the works written before World War II, in particular *Companions as Factors in the Bird's Environment* (Lorenz 1935)

and *Die angeborenen Formen möglicher Erfahrung* [*The Innate Forms of Possible Experience*] (Lorenz 1943). The second group is made up of a single and very relevant piece of work: the unpublished text from the conference *Referat über Jakob von Uexküll* (Lorenz 1948).[33] The third group includes writings from the period following World War II, in particular *Behind the Mirror* (Lorenz 1973), *The Natural Science of the Human Species* (Lorenz 1996) and *The Foundations of Ethology* (1981). We will deal mainly with the writings from the two first groups for that is where Uexküll's influence is especially evident.

Before we go into detail about single pieces of work, the personal relationship that exists between the two scientists should be understood. The young Lorenz knows the major works Uexküll wrote up to the 1920s well, in particular the first and the second edition of *Umwelt und Innenwelt der Tiere*, and he maintains an intense correspondence with the Estonian biologist. His doctoral thesis entitled *Companions as Factors in the Bird's Environment* is published in 1934 in the *Festschrift* for Uexküll's seventieth birthday (see *above*, 41, n. 55). That year, when he is already quite well-known in Germany, Lorenz is contacted by Uexküll, by then director of the *Institut für Umweltforschung* of the University of Hamburg, to tell him he would like Lorenz as his possible successor. Lorenz accepts the proposal, but the project did not go as planned for reasons beyond either one's control – among which the different positions of the two scholars regarding the national-socialist regime (Föger and Taschwer 2001: 68). At that time, Uexküll and Lorenz were on good terms, as goes to show the large amount of text that Uexküll dedicates to Lorenz's research in *A Foray into the Worlds of Animals and Humans.* World War II and Uexküll's death puts an end to their personal relationship.

Now let us move onto a brief analysis of *Companions as Factors in the Bird's Environment*. In the introduction to the work, Lorenz indicates the main subject matter of his study, defining it as an investigation into the modality with which animals perceive objects, including conspecifics, and into the differences between animals and man in their cognitive relationship with the environment. Both questions have precise links to Uexküll's approach, starting with the choice of using the Kantian doctrine of the subject in a biological light, thus trying to establish a clear system of similarities and differences between the perceptual and categorical apparatus that Kant observes in the human being and the cognitive structures of other animal species.

To give an emblematic example of the Kantian language that Lorenz uses, we report the following definition: "The concept of an object in our environment arises from a process of compilation of stimuli emanating from one given thing, by means of which we relate the assembled stimuli to that particular source of stimulation (the

[33]The writing, dated October 19, 1948, whose original title is "Referat über J. v. Üxküll", is kept in the Lorenz archives of *Konrad Lorenz Institute for Evolution and Cognition Research* in Klosterneuburg (Austria). It is an unpublished transcript by Hilde Fürnsinn of a seminar held by Lorenz after he returned from a Russian war prisoners' camp. For more details see Mildenberger 2005: 431.

"thing")" (Lorenz 1935: 101). A little further, Lorenz describes the process with which the stimuli, once perceived and unified in the thing, are projected outward into external space – a process that undoubtedly recalls the *Hinausverlegung* of the nervous excitations described by Uexküll. Finally, after pointing out that an environmental element is established as a thing-like unity by formal permanency – i.e. by the "inherent spatial correspondence" of the stimuli – Lorenz observes that this mutual co-belonging is the basis of Uexküll's definition of object: "an object is that which moves as a unitary whole" (Lorenz 1935: 101; the reference is to von Uexküll 1909: 197).

Like in Cassirer, the typical perceptive organization of man is therefore the systematic understanding of objects characterized by identity and persistence in time, while the behavior of animals does not seem to be based on a thing-like consistency of the perceived object: in different vital situations, the object might not be recognized as identical by the animal. What strikes the human observer most of all are the cases in which the lack of recognition also regards conspecifics of the perceiving subject – children, siblings, reproductive partner, etc. In *Companions as Factors in the Bird's Environment*, Lorenz deals specifically with the question of individual recognition of conspecifics in different life situations:

> One would at first expect that higher animals, to which we must attribute the concrete perception of objects in their environment on grounds of general behaviour, would also perceive the stimulatory sources related to all their instinctive behavior patterns as objects. One is particularly prone to make this supposition in cases where a conspecific represents the object in a particular response. Strange as it may seem, in many cases a cohesive identification of the conspecific as one object linking several behavioral complexes cannot be demonstrated (Lorenz 1935: 104).

The fact that Lorenz chooses to use the Uexküllian term of functional circle is very relevant; in particular, in the behavior of birds he identifies five functional circles of a social type, of which each one respectively pivots around the parents, the siblings, the members of the group, the reproductive partner and the offspring. Lorenz highlights how each relational situation corresponds, on one hand, to a particular constellation of perceived stimuli that are "carried" by the conspecifics, and on the other hand, to the activation of defining schemata and innate behaviors. For example, the behavior of parental care is induced in the parents by a particular coloration inside the offspring's beak or by very specific movements by them (that Lorenz calls "begging movements"); the same happens in behavioral sequences of courting and mating in the hierarchical relationships between social animals, etc.

Therefore, for Lorenz too, the functional circles differ according to the different environmental features that are highlighted in them. In the case of functional circles inherent to social life, the emerging features are represented by the conspecifics' characteristics: colors, acoustic signals, and body motions. The ethologist concentrates on the situation where a bird – interacting with the same conspecific but in different functional circles (for example, first in the functional circle of the hierarchical relationship, then in that of courting) – reacts to different combinations of triggering stimuli and consequently "does not realize" that it is interacting with the same individual. In the precise sense of the word, Lorenz notes at the end of this

reasoning, the term *companion* stands for "a conspecific which is only responded to as an identical whole within a single functional circle" (Lorenz 1935: 245).

Now let us comment the 1943 text, *Die angeborenen Formen möglicher Erfahrung*. First, we need to highlight the different nature of this text compared to the previous one. While *Companions as Factors in the Bird's Environment* is the presentation of Lorenz's first experimental researches, *Die angeborenen Formen möglicher Erfahrung* is more of an epistemological essay that intends to explain the categories of human thinking in evolutionary terms, demonstrating its phylogenetic origin and its adaptive value.[34] In this text, in which Uexküll begins to lose importance, the first critical stance on the Estonian biologist appears:

> [Our goal] is a precise comparison of the most world representation systems possible, chosen amongst the most different ones possible, following a similar method to the one Jakob von Uexküll adopted in his environmental research [*Umweltforschung*] but with the exact opposite intent; we want to reach the unique, extrasubjective and at the same time connected with all the subjects, reality, which is basically denied in Uexküll's environmental theory [*Umweltlehre*] (Lorenz 1943: 353).

To what is due this contrast between *environmental research* and *environmental theory*, which Lorenz detects in Uexküll? The problem can be summarized the following way. According to Lorenz, if Uexküll accentuates the radical separation between the environments of various animal species, it is because he is Kantianly convinced that the reality behind the perceived characters of different species is an unreachable thing in itself. The cognitive structure of every species would therefore be a barrier that separates every species' "world" from both the external reality and the other species' environments. In Lorenz's criticism of Uexküll, two observations that can be directed even against Kant appear again: the first is to allow the existence of a thing in itself that is unknowable by definition, and the second is to close the subject within the circle of its transcendental representations.

The theoretical foundation of Lorenz's criticism is represented by the Darwinian theory of evolution by natural selection, which Uexküll did not agree with, but which is the basis of Lorenzian ethology. From Lorenz's point of view, the correspondence between the cognitive structure of the organism and the extrasubjective reality is the result of a gradual and uninterrupted process of adaptation; ultimately this correspondence comes from the fact that possible losses in contact with extrasubjective reality are sanctioned by the danger of extinction for the species in which they appear. For example, according to Lorenz, the category of cause – which

[34]Lorenz writes *Die angeborenen Formen möglicher Erfahrung* in the brief period when he is teaching at the University of Königsberg, where he is summoned to be professor of human psychology in 1940. The fact that a Darwinist biologist and animal behavior scholar could be named professor of human psychology was seen by many as a clear sign of the times; the main supporters of the prestigious transfer are the philosopher Baumgarten – who nominates Lorenz because of his scientific merits and, pragmatically, because of his compatibility with the dominant cultural and political atmosphere – and the head of the SS office for biological matters, race and heredity, Heinrich Harmjanz. For further particulars on the subject see Föger and Taschwer 2001: 123–127.

for Kant is "prescribed", i.e. imposed by the subject to the world of experience – cannot not correspond to the real relationships between the objects and events of the extrasubjective reality, or else the behavior based on that category would become less efficient or not efficient at all.[35]

Curiously, in the 1943 text, the Lorenzian criticism about the thesis of environmental isolation is addressed more to Kant than to Uexküll (Lorenz 1943: 352); this is explained not only by the circumstances of the elaboration of the work (Lorenz was asked to take over Kant's teaching post), but also by Lorenz's desire not to break away from Uexküll. This line of criticism would have meant directly confronting Uexküll's anti-Darwinism: if for the Estonian biologist the species-specific environments are radically different from each other, this it is not only due to Kant's influence, but also to the belief that animal species are established and unchangeable realities. Once this point unveiled, the separation between the two scholars would have been unbridgeable.

We will now turn to the unpublished conference *Jakob von Uexküll* (Lorenz 1948), the only text by Lorenz that is completely dedicated to the theoretical biology of the Estonian scholar. The conference focuses on the idea, which had already been formulated in 1943, that there is in Uexküll a strong contrast between a positive research practice about the environment and a misleading theoretical component. It is also worth noting the opening words to the text, that perfectly summarize the complexity of the Lorenzian attitude:

> Uexküll – die-hard vitalist, staunch idealist, Kantian – actually an enemy of natural science, because "the environment of every man is separate from that of another", a sort of monadology [. . .]; what he writes about philosophy and vision of the world, is hair-raising for any naturalist. – But, true to the double life that idealist naturalists often lead, he is still the most accurate researcher in physiology. – Stubborn almost to the point of madness, absolutely brilliant (Lorenz 1948: 1).

As this incipit announce, the entire conference is built on alternating criticism and manifestations of esteem. If on one hand Uexküll is described as a bitter enemy of the evolutionary theory of natural selection ("In Uexküll there is no adaptation because for him there is no evolution, there is no phylogenesis; for him, all animals are given entities – so the building-plan is a miracle of creation which he does not approach to investigate" (Lorenz 1948: 1)), on the other hand, Lorenz does not hesitate to recognize the value of the main Uexküllian concepts, from the functional circle to the Umwelt. We even find the surprising but founded affirmation that if Uexküll had only developed this second part of his thinking, he could be considered a sort of "good behaviorist". In fact, Lorenz writes that his vitalism

> does not stop Uexküll, however, from giving extraordinarily precise causal-analytical descriptions of animals. Had we not read the previous paragraphs, we would believe to

[35]It is the position sustained by Lorenz in the essay *Kant's Doctrine of the A Priori in the Light of Contemporary Biology* (Lorenz 2009). This line of research was then continued by Lorenz's pupil Rupert Riedl (see Riedl 1990).

> be facing a behaviorist whose approach is an absolutely objectifying one – nevertheless a behaviorist who is not blind towards totality, and can see the animal's adaptive integration [*Einpassung*] in the environment (Lorenz 1948: 1).

But the main criticism found in the 1948 conference consists in the direct and explicit condemnation of the theory of the separation of environments. That theory seems to lead to a kind of solipsistic monadology in which the animal is confined in its representations:

> Uexküll does not believe in the outer world, he does not believe the sun really shines in the sky; on the contrary, [he thinks] that everyone has their own sun and he refuses the existence of an absolute world ("multi-mundane image of the world"). World of an animal: what is represented from the outside world in his central nervous system (Lorenz 1948: 4).

But the most important statement may be the following:

> Uexküll states that higher brains do not limit themselves to knowing the world through a sign language [*Zeichensprache*], but reflect it in the spatial dimension of their brains – this is the "counter-world". An animal that can spatially see a hostile object does not flee from a stimulus, but from the image of the object. The motor part of the nervous system has lost its connection to the environment. Stimuli are now only second-hand, [they come] from a new world of excitation [*Erregungswelt*] placed between the environment and the central nervous system. [The motor part of the nervous system] reacts to image (Lorenz 1948: 5).

It is obvious that Lorenz does not disagree with the idea that the animal is in relation to external reality through a sign language, but with the hypothesis that this semiotic interposition coincides with the creation of a "second world" separated from objective reality, specifically the environment. If this were so, the neural and cognitive structures of all species – in their role of conveying, by reinterpreting them, external stimuli – would become a kind of subjective prison that living beings could not break. At the end of the conference, Lorenz clearly disapproves of Uexküll's idea that "environmental stimuli surround the animal like a wall built against the whole foreign world" (Lorenz 1948: 6):

> I would say instead: it is precisely through this environment that the animal experiences the world, even if the model used is pretty rough. Animals and humans have different models, which are nevertheless compatible. To me, the fact that, despite this, Uexküll still doubts reality and the relative perceptibility of the outside world, is absurd and incomprehensible, and makes me furious (Lorenz 1948: 6).

Finally, let us come to the post-war texts, starting with a quick word about *Behind the Mirror*. This work merges most of the material already published in 1943 in *Die angeborenen Formen der möglichen Erfahrung*.[36] In this revised form, some

[36]The choice to rework the 1943 text is due to two reasons: on one hand, Lorenz wanted to update the thesis of that text with the scientific results that had emerged in the meantime; on the other hand, he had to amend the text from expressions that were too close to social-nationalistic language. This is no place to start a complete evaluation of Lorenz's eventual allegiance to the Nazi ideology, but Lorenz certainly could not publish a text in 1973 that (like in the 1943 edition) included paragraphs entitled *Die Selektion des Unerwünschten* [*The Selection of the Undesirable*] or *Der Wert der Reinrassigkeit* [*The Value of Racial Purity*] (Lorenz 1943: 299, 311).

references to Uexküll remain (including the definition of the object as environmental element that moves as a unit (Lorenz 1977: 199), but they almost exclusively support other arguments. Meanwhile the accusation of "solipsism" is missing (which is maintained for Kant, even though it is in weakened form (Lorenz 1977: 23–28)). The general impression is that Uexküll loses importance in this text both as a positive model of environmental research and as a negative reference.

From *The Natural Science of the Human Species*, Lorenz criticizes Uexküll more directly, most of all as vitalist and defender of the existence of harmonizing teleological forces in nature. Among the limits that these coordinates pose to the Estonian biologist, Lorenz points out the incapacity to explain not only the origin of the species, but also their extinction. However, at the same time, he says Uexküll is right on one very important point: those who believe that evolution by natural selection arranges organisms on a scale of increasing adaptive perfection, where higher animals and humans would result as better adapted than lower animals, are making a basic mistake. Against this mistake, which is attributed to his interpreters, not to Darwin, Lorenz writes:

> Jakob von Uexküll was entirely justified in stating that all living organisms are *equally well adapted* to their environments. In fact, one could more justifiably reverse the widespread view and state that the survival of higher forms of life is generally *more* threatened than that of lower organisms (Lorenz 1996: 93; italics by Lorenz).

In other words, once the vitalist faith in the total teleology of nature is overcome, the Uexküllian idea of an adaptive insertion (*Einpassung*) between organism and environment therefore stays valid; but it is accompanied by the awareness that extinction is always possible (because of a sudden climate change or the appearance of a new species).

Lorenz similarly critiques Uexküll's "doubtless exaggerated claim" that

> there are absolutely no rudimentary organs. When faced with such tenets, which are always guided by the vitalistic belief that all living organisms are occupied by a directing 'factor', one must always remember the principle stated above, that even *nonfunctional features* [*das Unzweckmäßiges*] may be preserved as long as they present no threat to the survival of the species (Lorenz 1996: 129; italics by Lorenz).

Therefore, the existence of harmonizing teleological factors contrasts with the Darwinian concept of the contingency of evolution, a contingency that is demonstrated by the possibility of extinction and the presence of evolutionary "attempts" (rudimentary organs) whose adaptive value is still unknown.

Also in *The Natural Science of the Human Species*, Uexküll appears alongside other vitalistic scientists in a passage reaffirming the above mentioned contrast between good practice in empirical research and bad theoretical background:

> It is a question of belief whether one feels in one's heart that there is something supernatural that is immune to research. As a *researcher*, however, one *must* be a mechanist. Even the great vitalistic natural scientists, ranging from Müller and Bernard to Uexküll and Driesch, arrived at their greatest and most enduring achievements in cases where they approached life processes with purely mechanistic working hypotheses. As *researchers*, they too were mechanists! (Lorenz 1996: 195–196; italics by Lorenz).

Finally, let us come to *The Foundations of Ethology*, which is a fundamental text in defining the disciplinary autonomy of comparative research on behavior. Even in this work, the criticism of vitalism continues to play an important role in the references to Uexküll, in particular, the idea of the unexplainable agreement that according to the Estonian biologist would support the relationship between organism and external reality. So writes Lorenz:

> Every "learned behavior" does contain phylogenetically acquired information [...]. Whoever denies this must assume a prestabilized harmony between the environment and the organism to explain the fact that learning – apart from some instructive failures – always reinforces teleonomic behavior and extinguishes unsuitable behavior. Whoever makes himself blind to the facts of evolution arrives inevitably at this assumption of a prestabilized harmony, as have the cited behaviorists and the great vitalist Jakob von Uexküll (Lorenz 1981: 9–10; italics by Lorenz).[37]

To define the vitalistic belief in the action of final causes that would make organisms and environment "agree", the Austrian ethologist goes to the point of using very strong expressions like "miracles" and "prestabilized harmony". The distance from Uexküll appears unbridgeable.

In conclusion, Lorenz's research and Uexküll's reach major agreement in *Companions as Factors in the Bird's Environment*, while the most explicit and "tormented" distance is found in the 1948 conference. In the course of the post-World War II era, even though there is much positive esteem about Uexküll's work, the Estonian biologist's influence in Lorenz's work becomes more sporadic and less clearly distinguishable, while the incompatibility between the Uexküllian and Lorenzian theoretical stances are pinpointed. Besides, after the war, Lorenz is clearly less interested in the study of the phenomenological and representative side of animal behavior; the attention to the possible ways of organizing sensorial stimuli (for example, the question of the individual recognition of the objects by the subject) gives way to the objective study of triggering stimuli and physiological states. The goals of his research disregard the question as to how the *animal categorizes the perceived*; instead, Lorenz concentrates on the identification of threshold values of stimuli and on major or minor reactions of animals in various natural and artificial situations. His attitude can even lead us to believe that Lorenz started to consider the problem of categorizing in subjective experience either unessential or unsolvable.[38]

[37] In addition, Lorenz observes, "the hypothesis made by Kuo and other behaviorists, that the mechanisms of learning "know" without any previous experience what is and what is not useful for the organism, contains the covert postulation of a prestabilized harmony to which the great vitalist, Jakob von Uexküll, overtly testifies. If one does not believe in miracles – and a prestabilized harmony would be one such – it remains simply incomprehensible where, for example, within the aquarium in which the young stickleback was reared [...] the information should be contained that the rival to be attacked is red on the ventral side" (Lorenz 1981: 58).

[38] Relevant to this point is the short text, *Do Animals undergo Subjective Experience?*, where Lorenz refuses the fact that one can understand the subjective experience of animals starting from their overt behavior (Lorenz 1963).

7.4 Sebeok and Contemporary Semiotics

Contemporary semiotics begins to pay significant attention to Uexküll with the book by Thomas Sebeok *The Sign & Its Masters* (Sebeok 1979); in turn, Sebeok refers to René Thom's work (see for example Thom 1968)[39] and to an article by Thure von Uexküll, entitled *Die Zeichenlehre Jacob von Uexkülls* [*The Signs Doctrine of Jakob von Uexküll*] (see von Uexküll 1979).[40] From this point on, Uexküll's name appears very frequently in specialist magazines, mostly associated with the interpretive line inaugurated by Sebeok, which culminates in the idea that semiotics must include biosemiotics and zoosemiotics as integral parts of it.

Sebeok is inspired by Peirce, an author who is a classic in semiotics, and by his definition of sign: "A sign, or *representamen*, is something which stands to someone for something in some respect or capacity" (Peirce 1965: 135). However, coherently with the Uexküllian approach, Sebeok goes beyond Peirce by attributing interpretive abilities to non-human subjects too (i.e. the animals' ability to "feel" that something stands for something else). The belief that the existence of signs and interpretation processes (the phenomenon of *semiosis*) is not just a typical feature of the cultural or human sphere but characterizes all of living nature leads Sebeok to find in Uexküll "a highly original, elaborate, and biologically sophisticated theory of signs", and even sustains – maybe excessively – that Uexküll considers semiosis "as *the* criterial attribute of life" (Sebeok 1979: x).

As one can expect seeing his interests, Sebeok pays much attention to *A Theory of Meaning*, where Uexküll is closest to semiotics, but – more surprisingly – the basis of his reflections comes from *Theoretische Biologie.* In particular, Sebeok is one of the few interpreters, and probably the only one with such great depth, to deal with the complex structure of transcendental signs that, in *Theoretische Biologie*, build the basis of the species-specific environment: spatial and temporal signs, operative steps and content-qualities (see *above*, 108–115). As far as that structure is concerned, Sebeok observes in *The Sign & Its Masters:*

> [Uexküll's] view of spatial and of temporal qualities, which Kant had called "the material", was cast in a semiotic frame. It begins with a sophisticated, elaborate, and original classification of signs, the complexity of which can only be hinted at here, but which should be understood as a steady striving for a kind of *information ecology* (Sebeok 1979: 196; italics added).

[39]Thom makes a relevant *trait d'union* between the reception of Uexküll by the French philosophers, which paid a lot of attention to the notion of meaning in biology, and contemporary semiotics.

[40]Thure carried on spreading his father's theory, from a semiotic point of view, not only with many articles but also with the "Introduction" to Uexküll's *Kompositionslehre der Natur. Biologie als undogmatische Naturwissenschaft. Ausgewählte Schriften* [*Doctrine of Nature as Composition. Biology as Non-Dogmatic Science. Selected Papers*] (von Uexküll 1980) and with the republication of *Die Zeichenlehre Jacob von Uexkülls* in the large collection of studies about semiotics entitled *Die Welt als Zeichen* [*The World as Sign*] (see von Uexküll 1981).

Furthermore, Sebeok proves to be fully aware of the Kantian roots of that "semiotic frame", and therefore of the fact that, for Uexküll, the environment is not a mere perceptive selection of the external world, but an active phenomenal production:

> The startling implication of Kant's view of space, and of time as well, is that an organism cannot, through sense perception, be immediately aware of things [. . .] as they really are, because spatial and temporal objects are altered in the very act of being apprehended [. . .] The world known through the senses, i.e. Uexküll's Umwelt, can only be a phenomenal world (Sebeok 1979: 194).

As we have seen before, the Uexküllian theory of the constitution of the environment is indeed based on following process: the stimuli from the external reality are altered at the same time as they are perceived (which is why their origin is destined to remain unknown), then they are translated into a sign language whose code is furnished by the organism itself, and finally, they are re-transposed outward (*hinausverlegt*) according to the rules established by the building-plan. Quoting a lesser known essay by Medawar and Medawar, Sebeok brings the existence of this process of active translation by the organism itself to the attention of semiotics: "Sense organs "respond to changes [in the real universe] and translate them", in the manner of transducer mechanisms [. . .] "into the currency of nerve impulses"" (Sebeok 1979: 195; Medawar and Medawar 1977: 175).

Going back to the essay on Kant by Lorenz (2009), which has a strong Uexküllian stamp, Sebeok states that the image of the external world that emerges from this process can be considered as a mental model, so much so that the term Umwelt comes to the point of including among its meanings "expressions as *cognitive map* or *schema"* (Sebeok 1979: 194). Sebeok reveals also that we should not expect a map to mirror the external world perfectly, or it to be isomorphic with the latter:

> The *Umweltlehre* of Uexküll requires no more than that the categories of experience and knowledge be isomorphic to the real universe – not that the two halves of [functional] cycle [the perceptive and the operative worlds] fully correspond with one another, let alone that the *Innenwelt* completely represent the world (Sebeok 1979: 203).

Sebeok's interpretation also highlights the limits of the Uexküllian thinking, from the problem of environmental relativism to the refusal of evolution, to finally recognizing the permanence of a vitalistic stance. Regarding this last point, however, it is important that Sebeok considers the role of operative signs positively, almost without looking into the problems linked to the origin of such "endogene information" and their agreement with the external world (an agreement that is only explained in Uexküll's theoretical context of the universal harmony of a nature that is meant as a supreme teleological force) (Sebeok 1979: 9–10). What he considers much more important are the possibilities opened by Uexküll to conquer new territory in the investigative domain of semiotic instruments; in particular, Sebeok sees three research directions out of Uexküll's environmental theory: anthroposemiotics, zoosemiotics and endosemiotics (i.e. the study of intraorganic stimulation considered as signs) (Sebeok 1979: 26), the last two of which he considers extraordinarily innovative.

Sebeok's attention to Uexküll also continues in the later texts. *Signs. An Introduction to Semiotics* confirms all the above points once again (Sebeok 2001: 100–101, 143–146), with the addition of a deeper understanding of the philosophical implications of the Uexküllian theses. Here Sebeok considers Uexküll's contribution to be precious not only to define "the relationship between object (O) and sign (S)", but also, on a larger scale, the one between reality and image of the world:

> Our intuition of reality is the consequence of a mutual interaction between the two: Jakob von Uexküll's private world of elementary sensations (*Merkzeichen*, "perceptive signs") coupled to their meaningful transforms into action impulses (*Wirkzeichen*, "operative signs"); and the phenomenal world (Umwelt), that is, the subjective world each animal models out of its 'true' environment (*Natur*, "reality"), which reveals itself solely through signs (Sebeok 2001: 33).

In the essay from 1979, this position coincided with a certain preoccupation about the problems that it created (especially relativism); in the 2001 text, instead, it is accompanied by a – somewhat surprising – acceptance of the risk of idealism that it leads to:

> This position [...] is known as idealism, and that of a particular hue, sometimes called "conceptual idealism", which maintains that our view of reality, namely, our Umwelt, entails an essential reference to mind (*Gemüt*) in its constitution. As Kant insisted – and, of course, both Peirce and Jakob von Uexküll had thoroughly assimilated Kantian principles – "raw experience" is unattainable; experience, to be apprehended, must first be steeped in, strained through, and seasoned by a soup of signs. For this reason, this brand of idealism can be called "semiotic idealism" (Sebeok 2001: 36–37; the expression "semiotic idealism" originally comes from the Canadian philosopher David Savan; see Savan 1983).

This turning point is a coherent development of the former positions (first of all, the detection of the missing isomorphism of the Umwelt with the external reality) and it is completely in line with the Uexküllian positions. Even though it does not directly confront the problem connected with the harmonization of different species-specific environments, we should mention that Sebeok (who had already refused Uexküll's vitalism and anti-Darwinism positions as early as in 1979) accepts the evolutionistic background of contemporary studies on animal communication and behavior. He thus gains a connecting infrastructure to "harmoniously tune" the different environments conceived idealistically. Incidentally, this position does not come without theoretical problems. The first roots in the very choice to elevate a particular system of signs (the evolutionary theory, which is part of the current vision of the world by the human species) to a meta-environmental – and so meta-semiotical – component valid for all environments.

Through Sebeok's mediation, Uexküll's environmental concept (in the particular version found in *A Theory of Meaning*) has been widely accepted in the last few decades in the semiotic and biosemiotic field. We can even say that, currently, mainly scholars who belong to this discipline are conducting the research on Uexküll: particularly Kalevi Kull (see in particular Kull 1998, 2003, 2004; Emmeche and Kull 2011), John Deely (see in particular Deely 1990, 2004), Riin Magnus (see Magnus 2008, 2011a, b, c; Magnus and Kull 2012), Torsten Rüting (see Rüting 2004), Morten Tønnessen (see in particular Tønnessen 2009, 2011,

2014) and, from the particular perspective of code biology, Marcello Barbieri (2003, 2008, 2009, 2012). On a worldwide scale, one of the centers where the research on the semiotic aspects of Uexküllian biology is currently performed more intensely is at the *Jakob von Uexküll Centre* in Tartu (Estonia),[41] under the direction of Kull. Alongside the *Jakob von Uexküll Centre*, the *Uexküll Archiv* of the University of Hamburg, opened in 2004 by Rüting (see Rüting 2004) is another international center for research on Uexküll. As regards publications on Uexküll's interest in semiotics, the monographic issues dedicated to the biologist of the magazines *Semiotica*[42] in 2001 and *Sign Systems Studies*[43] in 2004 should be mentioned. Referring to the journals for a more in-depth overview of their contents, we will limit ourselves here to observing the wide variety of subject matter that these articles deal with (and that largely reflect the current ramifications of the Uexküllian research); while the perspective of these publications is clearly semiotic, they have connections to philosophy, mind theory, hermeneutics, cybernetics, linguistics, art and literature; we also find important attempts at reconnecting Uexküll's thought to contemporary theoretical biology and at highlighting possible ecological implications.[44]

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[41]For a presentation of the *Jakob von Uexküll Centre* see Magnus et al. 2004; among the most recent publications, see Lindström et al. 2012.

[42]See *Semiotica* CXXXIV, no. 1/4 (2001): "Special Issue. Jakob von Uexküll: A paradigm for biology and semiotics".

[43]See *Sign Systems Study* XXXII, no. 1/2 (2004).

[44]Uexküll's importance in contemporary biosemiotics is also demonstrated by the frequent references to his work in the recent collective volume *Biosemiotic Research Trends* (see Barbieri 2007).

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Chapter 8
Conclusion

Abstract This conclusion presents, in a synthetic manner, some key points of Uexküll's conception of nature and life: the idea of the Umwelt as a species-specific construction that is both transcendental and semiotic, the presence in Uexküll's work of elements of vitalism and teleology, the possibility to use his concept of Umwelt as a useful theoretical tool for preserving biodiversity.

Keywords Transcendental biosemiotics • Vitalism • Teleology • Umwelt-based biodiversity

8.1 The Formation of the Umwelt: Perceptive Selection or Transcendental Constitution?

Our review of the readings and interpretations of the Uexküllian thesis is a good starting point for highlighting its key turning points and possible directions for further development. As we have seen, all the interpreters rate the anti-anthropomorphic value of the Uexküllian environmental theory positively, in particular the belief that every animal is an autonomous entity, around which there is an original "world", which is irreducible to the others both in terms of its contents, and in terms of its formal coordinates. Usually, the claim of the spontaneous capacity for action of the subject animal is an integral part of this version, a claim that can be fully understood only against the background of opposition to Darwinism in the second half of the nineteenth century and the first decades of the twentieth; in this historical phase, the evolutionary idea tended to see every aspect of the lives of animals as the product of the mechanical action on the organism from the environment, intended materialistically.

Although many interpreters did not fully realize it, the claim of the spontaneity of the subject is closely tied to the Kantian roots of the Uexküllian approach. To grasp this, we must keep in mind that the *Critique of Pure Reason* can also be read as an attempt to reassert the prerogatives of the rational subject faced with a natural science of objectifying inspiration which is becoming more accurate and reliable in its explanatory and predictive capacity. What Kant achieved, therefore, is a bold theoretical operation following which the strengths of natural science do not

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disappear but, so to speak, are re-allocated; in other terms, Kant did not think the reliability and certainty of natural sciences came from the order of the world, but from the subject's organizing structures. The same thing happens in Uexküll: the meaning of the Umwelt does not derive from objective pre-existing connections, but is established by the animal subject, who thus becomes the lawmaker of that world (simple or complex) in which his whole life unfolds.

Full understanding of Uexküll's thought is therefore linked to the recognition of its Kantian roots, and this starts precisely from the fundamental question of the formation of the Umwelt. The interpreters who see the environment as the result of the perceptive selection that sense organs exercise on external reality – starting from Scheler and the other representatives of German philosophical anthropology – do capture Uexküll's anti-anthropomorphic intent (the diversity of the sense organs leads to different selections and so to different environments), but not his will to grant legislative autonomy to the subject. The line of reasoning of the present work, instead, wants to show how, in Uexküll, not only the external reality, but also the single, isolated sensations are in themselves inaccessible to the animal subject: its sensory experience is indeed the result of the immediate translation (i.e. alteration) of the sensations in a code of nervous excitations which – as the author points out several times – has no mimetic connection to the external reality. The shapes and images with which we experience the world do not reflect the external objects, nor are they isomorphic to them; they must have a denotative function, they must *stand for* the object – otherwise they would have no effect at all: the predator could not meet the prey, and during courtship the male may be ignored by the female –, but this rapport is the result of perceptual recognition, on the subject's part, of an environmental element that it itself has previously formed from processes occurring in its nervous system.

This point is stated radically. For Uexküll, sensory excitation is undifferentiated: whether they come from the optic, olfactory or acoustic nerves, the quanta of excitation do not show qualitative differences. Such differences are added by the subject, starting from the attribution to the one or the other sensory field. Of course, only in a body with visual organs can a field of optical impressions appear, yet the use of the organs does not mean passively registering a sector of the outside world, but rather mastering an almost artistic mode of expression. The greater richness of the environments of higher animals, therefore, is not so much dependent on a greater range of sensory selection from the outside world as on a higher capacity of modifying, processing and re-combining the excitation quanta transmitted by the central nervous system.

In addition, as we have already seen, according to Uexküll the spontaneity of the animal organism is not limited to the differentiation of the stimuli or to the establishment of the various perceptive fields. These operations, in fact, take place entirely within the subject (i.e. in that inner physiological world which Uexküll opposed so vehemently to the naive idea of an animal psyche), while the constitution of the Umwelt requires, for it to be possible, the transposition outside (*Hinausverlegung*) of the perceptive fields and their contents. With this step – which is considered as a real "restitution to the world" of its inner activity – the subject

gives the environment and what moves in it a certain rhythm and a certain coloring, or rather certain rhythms and certain colorings depending on the functional circles with which its species is provided.

It is therefore no coincidence if those who (like Sebeok) recognize the transcendental and constitutive quality of the process of formation of the Umwelt can also grasp the semiotic and hermeneutic aspect of the Uexküllian environmental theory. Uexküll – more clearly in *A Foray into the Worlds of Animals and Humans* and in *A Theory of Meaning*, in a more complex but also more profound way in *Theoretische Biologie* – puts in a big theoretical effort to show how the activity of the animal subject has an interpretative nature: the undifferentiated excitation is translated into signs, and those signs have a meaning (they stand to someone for something, using Peirce's above-mentioned definition) and must be processed according to it. They are further divided into the two major categories: that of the perceptive signs coming from the outside – or rather, reperceived as coming from the outside after the *Hinausverlegung* – and that of the operative signs of intraorganic origin. In the first case, the interpretation is of a cognitive type; in the second, it takes place through action and is not usually reperceived.

With this idea of an interpreting organism and the importance given to grasping environmental signs in animal behavior, Uexküll provides us with an original and innovative continuation of the Kantian transcendental method. On the whole, the Estonian biologist's approach can be defined as a transcendental biosemiotics, since the environment is species-specific and is constituted a priori as a system of signs. The complexity of this system is very variable, and can include many or few subsystems (functional circles) and many or few meanings. The human environment is perhaps the most complex system (as we have seen, the phenomenon of intraspecific variability of meanings arises here), but it is theoretically similar to the environments of non-human animals.

Incidentally, it is very likely that the lack of recognition of the lawmaking power of the animal subject, which goes hand in hand with the assumption of the theory of "selective perception", might be due to the wish of German philosophical anthropology (but also of Heidegger and Ebner) to preserve the qualitative difference of man compared to animals, which Uexküll's environmental theory does not accept. Conversely, Sebeok – whose starting point is semiosis as a natural phenomenon and according to whom animal and man are similar as interpreting subjects – recognizes the Uexküllian intent of unifying the animal and human worlds thanks to the idea of a species-specific environment endowed with sense. This is not tantamount to cancelling the differences between humans and animals (Sebeok is very attentive to the diversity of signs present on the various levels of the natural world), it aims rather to focus on an inclusive perspective and to avoid taking qualitative alterity as a starting point (or as an unavoidable result). In a historical-philosophical point of view, the idea of semiosis as natural phenomenon finds an antecedent of great importance in Merleau-Ponty's theory, according to which the animal environment is a phenomenological field endowed with sense and, therefore, represents a sort of pre-cultural sphere; Merleau-Ponty himself recognized the Uexküllian roots of this theory.

8.2 Vitalism and Teleology in Uexküll

Given the period in which Uexküll was educated, it is not surprising that in his work the claim of the spontaneity of the living is accompanied by strong antidarwinian and antimechanistic undertones, typical of the late nineteenth and early twentieth centuries neovitalism. However, as we pointed out, Uexküll's vitalism is very special. First, it does not completely exclude the analogy to the machine, which the author, especially in the first period of his production, uses as the basis for the empirical analysis of living organisms. We can, therefore, affirm that for Uexküll the living is a balanced system of mechanical traits and supermechanical properties. In some biological species the former significantly prevail, while in others the latter are more relevant: as in the amoeba and in all those organisms which display regenerative phenomena (except for the embryonic stage, in which the supermechanical properties always predominate). At the methodological level, this particular position requires a composite approach, which combines a vitalist theoretical framework with a mechanistic research practice (see Lorenz' accurate observations on the *de facto* mechanism of vitalists).

But even the most typically vitalist characteristics of the Uexküllian conception present specificities. First, Uexküll's view of the principle of life is definitely more Kantian than Aristotelian: the vital principle (the extra-material *Naturfaktor* that organizes embriogenesis and super-mechanical phenomena) is conceived on the model of Kant's noumenon, from which its empirical unknowability directly derives. This position is very different from that of Driesch, for whom the extra-materiality of entelechy did not lead to its unknowability (just as, in Aristotle, the fundamental distinction between matter and form does not signify the unknowability of the second). For Uexküll, and it is this belief that makes him a keen observer and a meticulous experimenter, only the phenomenon is directly knowable, while the noumenon, that should also be necessarily postulated, cannot be investigated but through its phenomenal effects.

This position gives rise to many problems, partly due to some inconsistencies of Uexküll's, and partly to inherent difficulties. Let us start with the first aspect: if it is true that, as Cassirer pointed out, Uexküll tries as much as possible to avoid making out of the natural factor a final cause directly involved in biological processes, it is also true that this intent leads to the insertion between *Naturfaktor* and material plain of intermediate instances which – like the building-plan, or the will of the organism, or the construction rules – present themselves, however, precisely as final causes. Furthermore, as Kant himself notes in *Critique of the Power of Judgment*, as regards the living, it is difficult to limit the analysis to the phenomenon strictly speaking (i.e. to empirical experience structured by the a priori forms of time, space and antecedent causes) because oftentimes a biological process does not reveal its meaning if it is not considered in a teleological perspective.

As is known, the immediate reference of the living to teleological causality is the reason of Kant's statement that there is no Newton yet "who could make comprehensible even the generation of a blade of grass" (Kant 2000: 271). However,

this is also the reason why Uexküll – not entirely consistently with his theory of the unknowability of the noumenon – often needs to make use of the effective action of the *Naturfaktor*. The most prominent example of this trend is the idea, repeatedly underlined, that the agreement between the various species-specific *Umwelten* is due to the harmonizing action of nature (or rather, of Nature). In this case, an elementary natural phenomenon, which plays a role in virtually every aspect of the relationships between species, is directly attributed to the effective action of the vital principle. The perceptive and operative agreement between species seems to have originated in the noumenal sphere and from there seems to radiate on matter – with the risk, among other things, of severely limiting that autonomy of the living being which Uexküll wishes to reaffirm.

This set of problems is closely related to the issue of which type of teleology Uexküll intends to express in biology. As he says in several passages, teleology can mean on the one hand purposiveness, goal-directedness or tension towards an end (*Zweckmässigkeit*), on the other compliance or conformity to a plan (*Planmässigkeit*); the Aristotelian and Drieschian teleology is of the first type, while the Uexküllian one belongs to the second. Uexküll uses this distinction, on one hand, to separate the teleological principle from the level of empirically observable phenomena, denying it the status of final cause and thus preparing the claim of its noumenal nature. On the other hand, he wants to point out that the teleological character of the living must never be thought in analogy with the intentional action of man: the teleological processuality of the animal and plant world is completely devoid of any kind of representation that could, so to speak, "anticipate" the end on the cognitive level. For Uexküll, the living conforms to a building-plan, but the building-plan is blind, not one bit self-conscious.

The affirmation of the blindness of the building-plan belongs to a broader strategy which aims to mitigate the less acceptable aspect of the Aristotelian finalism and of vitalism in general, i.e. the postulate according to which a future end (for example, the configuration of the adult organism in the formation of the embryo) can determine a process that takes place in the present, like a sort of magnet that acts in time by "attracting matter to itself". Uexküll rejects both the Aristotelian and Drieschian version of this theory (where the task of making the future act on the present is left to entelechy, a sort of spaceless and timeless archetype of the species), and the spiritualistic or idealistic versions, according to which ideas or visions of the future which are thought as able to organize the present and are supposed to act on matter (perhaps on an unconscious or unexpressed level).

The Uexküllian distinction between tension to an end and conformity to a plan, as well as his adhesion to the second type of teleology, is based on the intention to bring vitalism closer to the needs of contemporary science. This interpretation key also applies to the theory according to which the building-plan (i.e. an instance existing before the single biological process, which therefore does not overturn the chronological schema of antecedent causality) is responsible for embryonic organization (or for regeneration, or for the constitution of the environment), as well as to the theory according to which there are "material carriers" of the building-plan, or construction rules, which Uexküll sees in the genes. If this is true, however,

some questions remain unanswered: that of the relationship between *Naturfaktor* and intermediate immaterial instances, that of the means of transmission of the latter's causal efficacy to matter, and finally the (major) one regarding the type of finality of the natural factor.

Let us focus on the last issue, which is paramount above all in terms of the possibility of including Uexküll in the contemporary scientific mentality. Although his teleology does belong to the second type (i.e. is based on the conformity to a plan) as far as single organism and single environment are concerned, we do not know – and given its noumenal character, we might never know – to what kind of teleology the natural factor belongs when it is considered in itself. According to Uexküll, we know that it has established a comprehensive plan that includes the individual building-plans, that this plan is harmonious and organizes the relationships between organisms and specific environments smoothly, but we do not know if this plan has a purpose.

Bearing in mind that Uexküll did not leave any straightforward indications in that regard, let us attempt to examine the various prospects such a question allows. The first thing we will clarify is that according to his overall view, for Uexküll the (eventual) purpose of nature is certainly not man; for the Estonian biologist, mankind is a species among others, as is made obvious by the fact that his environment fits seamlessly within all the complex environments of higher animals. Besides, it is hard to even think that, for Uexküll, the ultimate purpose of nature's plan is its indefinite repetition: if the first phase of his thought did include fixity, in the latter stages, instead, he accepts the possibility new species could appear (not by natural selection, of course, but as a result of the general plan). Once the idea of biological becoming is accepted, however, any repetition of the general plan may take only one form, that of the cycle – and this conception is perhaps the furthest away from the way of thinking of Western science.

Once man and the cyclic repetition of the overall plan are excluded from the list of possible purposes, there are only two possibilities: either the general plan of nature – which now also includes the changes of living beings – does not have a purpose and unfolds in a random and unpredictable way (but it is very doubtful that Uexküll would have accepted the radical contingency of this solution), or it does have a purpose, but we do not know it. That brings us back to the declaration of noumenal unknowability of the natural sphere; yet, now we can see the overall sense of this prediction: it allows Uexküll to reconcile the certainty of order and the harmony of nature with openings towards further possibilities of development, which are, however, neither random nor mechanically predetermined.

8.3 Limits and Prospects of the Uexküllian Environmental Theory

In the present work, weaknesses in Uexküll's ideas emerged quite frequently, both in the analysis of the Uexküllian literature, and in the most significant reinterpretations by other authors. If isolated critiques are found in many interpreters, it is especially

Lorenz – to distance himself from an inconvenient master, but certainly without concealing his admiration and almost with a certain regret – who pointed out what aspects of Uexküll's conception of the environment and organism were incompatible with the contemporary scientific mentality. It is above all during the 1948 conference, which we discussed above, that all the criticism Lorenz directed at Uexküll's thought was put together: environmental solipsism, the monadic conception of the subject, the unverifiable postulate of natural harmony, the a priori rejection of the idea of evolution by natural selection, the failure to take account of biological phenomena such as extinction and, finally, the conviction of inaccessibility to empirical study of the ultimate principles of nature.

All these points are real and undeniable limitations, which need to be known, especially if it is the equally undeniable fruitfulness of the Uexküllian thought we intend to shed light on. And this does not mean to say that Uexküll's environmental conception is valid *despite* his vitalism, or *despite* his antidarwinism, but rather to say that – in the particular phase of theoretical biology in which he was active – the headway made by Uexküll is possible (paradoxically) only outside of the hegemony of official mechanism and Darwinism. It is thanks to his personal theoretical background that Uexküll can escape both from the over evaluation of the physical environment typical of the early evolutionists, and from the "fear of the environment" that seizes many philosophers faced with the rise of Darwinism and of the Spencerian philosophy; and it is for the same reason that he manages not only to conceive the animal in terms of subject, but also to extend to the environment itself the organizational spontaneity that mechanists were trying to deny even to organisms.

Similarly, the transposition in biology of the Kantian conception of the subject, despite the risks of solipsism that it undeniably brings with it, enables Uexküll to acquire what is perhaps the main strength of his approach: a relational conception of environment, very different both from the anatomical and physiological study of the animal, and from the analysis of the environment materialistically intended. In other words, in Uexküll, the consideration of the animal as a transcendental subject manifest itself in the tendency to think of living species and their ecology in terms of animal-environment systems; and this attitude even allows him to go beyond Kant, by turning the transcendental subject into an interpreting subject, and by turning environmental experience into a translating and interpreting process. So, if it is true that Uexküll does not succeed in offering satisfactory solutions to the problems that arise from Kant's position – and this applies to the closure of organisms in their environments, as well as to the "mystery" of the coordination between the various species-specific environments – it is also true that his intuition of a semiotic environment did not take shape *despite* the Kantian view but thanks to it.

If this is true, i.e. if the most convincing aspects of the Uexküllian environmental conception were made possible by the particular "anachronistic" theoretical background of the Estonian biologist, we cannot help but wonder what the situation is like today. Rather than as a monolithic ideological system, in effect, the evolutionary idea appears today as an active trend-setting field, in which it seems possible to include the Uexküllian conception to a much greater extent than in the past.

Once you get past the idea (simplistic even considering the writings of Darwin himself) that evolution is primarily a change in the organism brought about by the environment meant as material miliev, nothing stops us from imagining, if we expand the scope of the Uexküllian concepts, a natural evolution of the animal-environment systems, or even a natural evolution of the environments.

From the theoretical point of view, this would avoid at least some of the difficulties noted above. The idea of the evolution of the environments makes it possible to account for the correlation and coordination that exist between every single species-specific environment and the external reality, as well as between the environments of different species. Indeed, the animal-environment system can maintain itself over time and replicate – and without the fulfilment of these needs we cannot speak of life – only if the complex of signs on which it is based is at least minimally in touch with the external reality and with the system of signs of the other species. In the case of sexual behavior, one of the most studied field in contemporary zoosemiotics, minimal agreement must exist between the sets of signs of two conspecifics of the opposite gender. Thus – even if, on the ontogenetic and synchronic level, environment remains undeniably the product of the transcendental subject, or of the interpreting subject – phylogenetic and diachronic analysis shows how this subjective nature is not synonymous with solipsistic isolation.

Including the Uexküllian concept in an evolutionary theoretical context also requires, however, some alterations. The most important of which is admitting contingency in the formation and modification of environments: the animal-environment system, and the semiotic systems that it includes, evolve when their (spontaneous and unplanned) modifications meet the inorganic external reality and especially the other animal-environment systems, and this meeting reveals if they are compatible or incompatible with the minimum requirements for the conservation and replication of the living. And, in other words, this is equivalent to admitting the possibility of imperfection and/or of the extinction of animal-environment systems. While it rejects the possibility of its literal reinterpretation, this modification of the concept of Uexküllian Umwelt respects the deepest spirit of the author. Uexküll's astonishment faced with the exceedingly subtle agreement between the structure of a cobweb and the anatomical and cognitive characteristics of a fly can now relive as astonishment for the change processes that continue to put the vital functions and processes of the most diverse species in tune with each other.

In an ecological perspective, finally, the modification in the evolutionary sense of the Uexküllian *Umweltlehre* offers us greater awareness of the risk to which the animal-environment systems are exposed precisely because of their semiotical precision and finesse. Because if it is true that they are constantly evolving systems, it is also true that in the short term – that is, in the context of human history and the technologically induced acceleration that it has experienced in the last two centuries – the sign systems that supports every single environment are not able to keep pace with sudden changes; but, if the correct interpretive relationships between organisms and reality breaks, the result is the extinction of the species. The work of Uexküll, in other words, can help the contemporary ecological thought to understand that safeguarding biodiversity does not mean so much preserving "the animals" as

defending the *Umwelten*, the semiotic, perceptive and operative worlds in which life unfolds. With what we said previously in mind, the survival of a species in captivity or in an excessively anthropized environment presents no substantial difference from its physical disappearance, because the animal subjects that compose it are no longer able to exercise their abilities of transcendental constitution, and then of interpretation, of the biosemiotic environment; and without being able to express these fundamental aspects of their constitution, they cannot be said to be truly alive.

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