A Natural Symphony?

von Uexküll's *Bedeutungslehre* and its Actuality

The Baltic-German biologist Jakon von Uexküll, one of the founders of ethology, enjoys a renaissance these years, both in the discussions of biosemiotics and of "embodiment" in philosophy and cognitive science. Thus, von Uexküll's basic diagram of the "functional circle", characterizing every animal species, is central to the current biosemiotic attempts at understanding the foundations of biology. But von Uexküll's fertile idea is not unanimous – several different and even mutually contradictory ideas compete in his conception of it. This gives rise to certain dangers in biosemiotics which must be tackled in an analysis of what is invovled in the ontology of "functional circles". For an overall historical view, von Uexküll's theoretical biology is a main contribution to the "developmental" or "epigenetic" trend in the biology[i] of the recent centuries - and like so many of the contributions to this undercurrent of biological thought it is not without a certain involvement with vitalism. Since the establishment of the so-called "Neo-Darwinist" synthesis and the discovery of DNA, this tradition has been marginalized in the biology departments concentrating upon biochemical empirical research and a Neo-Darwinist philosophy privileging the genotype as the core object of biology. Consequently, the developmental or morphogenetic point-of-view with its interest in biological form and phenotypes has, as a tendency, been relegated to characters on the periphery of the biological institutions, e.g. ethologists, philosophers, semioticians, catastrophe theorists, complexity theorists, etc. From this exile, morphogeneticists keep claiming that biochemical reductionism will never be able to explain the phenomenon of the living being in its entirety - and is

consequently, from Neo-Darwinist side met with routine accusations for vitalism, the harshest four-letter word in contemporary biology[ii]. My contention is that there remains indeed valuable thought in this tradition, but, on the other hand, the vitalism accusations are often correct. What needs to be undertaken, then, is a task of criticism: the insights of the epigenetic tradition must be purged for vitalism in order to fit into our actual level of knowledge where *élan vital*, unknown organic force fields, and the like are definitely out of question.

Jakob von Uexküll is a perfect example of the ambiguity of this tradition - his work contains many acute critical corrections to our days' Neo-Darwinian orthodoxy in biology - at the same time as being marred with an irrationalist vitalism which is, at best, to consider aged. Its insistence on founding a theory of life *sui generis* - that is, not a theory with a physicalist reductionist perspective - is sound, in so far as it points to central issues nowadays left to ecologists, ethologists, and artificial life philosophers presumably dealing with more superficial layers of biology than biochemistry. Its central concept of "Umwelt"[iii] as the stable world of possible influences and reactions forming the environment of an organism is an important correction to a Darwinism taken to the extreme, taking genes and their mutations as its only ontological entities endowed with causal efficiency. Yet, on the other hand, von Uexküll's ardent anti-Darwinism and more general anti-evolutionism makes his theory a bizarre brand of creationism: the biological world is created by a "composer" - inferred from a throroughgoing musical metaphor in von Uexküll's thought, in turn inherited from von Baer[iv] - and even if von Uexküll must admit that the span of biological life must be counted in millions of years and whole kingdoms of animals, he does, in fact, little more than stretch the seven days of creation into a longer timespan for a composer god's work to unfold. These latter features of his thought, unfortunately, makes it a hard job to evoke a serious scientific interest in his endeavor.

To some extent, the picture is parallel in semiotics. Being one of the founders of biosemiotics *avant la lettre*, von Uexküll is, on the other hand, a semiotician whose conception of *Bedeutung,* of meaning, is to a large extent caught up in an subjectivist and skepticist ontology and epistemology which has little attraction for a modern scientific semiotics. Now that von Uexküll is once more being rediscovered - largely thanks to Thomas Sebeok's efforts[v] - there is no reason that semiotics should inherit what has hindered his influence in biology. In this chapter, I shall try to distinguish von Uexküll's fertile contribution to semiotics from its clothing in irrationalist

vitalism - being fully aware that in so doing, we might deprive him of some of his attraction for more *schwärmerisch* or constructivist admirers as well.

The semiotics of the functional circle

The backbone of von Uexküll's theory of meaning, of course, is his "functional circle" constituting and delimiting the *Umwelt* of the organism in question. The circle closes the two processes of perception and action, *Merken und Wirken,* into one continuous movement so that one becomes the presupposition of the other, and, consequently, the one becomes the *telos* of the other, in a neverending teleological circuit with no static goal[vi]: Perception is undertaken with respect to subsequent action, and action permits survival and further perception. In doing so, von Uexküll performs, in fact, a formal 'secularization' of the so contested notion of teleology. The telos does not consist in any goal outside the functional circle, but is simply defined by it.[vii] The organism is able to perceive a limited range of stimuli from the surrounding world only, and furthermore, is able to respond to those stimuli in a correlated series of specific actions, both to be conceived of in semiotic terms: both form signs to be read and performed by the organism. These stimuli and responses make
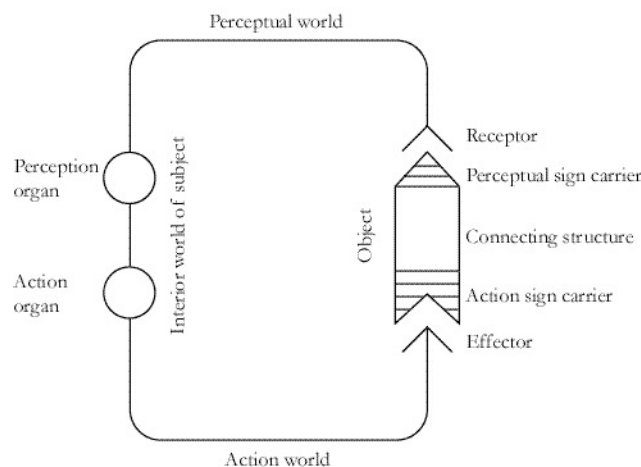
The functional circle. The Umwelt is made up of perception and action worlds

up its functional circle which, in turn, constitutes its *Umwelt* as the repertoire of relevant perceptions and actions.[viii] Thus, there are very large differences between the possible *Umwelten* of different species. To take one of von

Uexküll's favorite examples, the tick[ix], waiting patiently, maybe for years, on a tree for a mammal to come by, is deaf, blind except for a primitive luminosity sensivity and has a very limited sense of smell, tuned to detect butylic acid as a sign of mammal sweat. This *Merkmal*, if present, now releases a *Wirken*: The animal drops, and if hitting the mammal, its temperature sense guides it through its furs to the warmest – and thinnest – spot on the skin where the next *Wirken* takes place when it sinks its jaws into it and sucks blood in order to become able to procreate by parthenogenesis Guided by light, the young ticks crawl up on a straw or a leaf to repeat the cycle. Correspondingly, the *Umwelt* of the tick is very poor, constituted by light, temperature and the smell of butylic acid and containing mammals only - mammals, to be sure, which have very little (but not nothing) in common with our mammal concept in so far as they consist only of sweat, heat and blood, so to speak. On the action side, the *Umwelt* contains little more than waiting, falling, crawling, and sucking. Higher animals, of course, hold much more complicated *Umwelten*, but the common and defining feature of all of them is the fact that these *Umwelten* are constructions of signs - *Merkzeichen* and *Wirkzeichen*, respectively: perception signs and action signs. These signs as read by the organism give rise to the objects of its *Umwelt*, any object being composed of *Merkmale* and *Wirkmale*, respectively: perception properties and action properties. Thus, an equivalent name for the functional circle simply is: meaning circle.

Naturalized Kantianism

This, in itself groundbreaking, theory of a large variety of phenomenal worlds in different animal species is now interpreted in a strange ontology. The basic framework is inherited from Kant, and von Uexküll thus forms part of a tradition that could be called "neo-Kantian semiotics"[x]. Kant may, of course, be interpreted in several ways, and von Uexküll's Kantianism is not without problems. Taking his point of departure in a subjectivist reading of Kant, von Uexküll states that

> 'All reality is subjective appearance'. This has to be a great,
> fundamental understanding also of biology [...] The task of biology is
> to widen the results of Kant's research in two directions: 1. to take
> into account the role of our body, especially of our sense-organs and
> our central nervous system and 2. to explore the relations of other

subjects (the animals) to the objects. (quoted from Thure von Uexküll 1982, 9[xi])

This naturalization of Kant implies two worthwile endeavors as quoted: to extrapolate the phenomenal world's constitution from a naked transcendental subject and to the body in a Merleau-Ponty-like embodiment intution, and to extrapolate its range from our species only and to other species in an ethological intuition. But at the same time, von Uexküll - as is evident from the opening statement in the quote - falls prey to a widespread German temptation at naturalizing the constitutive subjectivism as well, with a result not entirely different from Nietzsche's perspectivism. The semiotic theory just outlined is seen as the constitutive theory of all other possible thought; physical laws of nature, for instance, become mere extrapolations and abstractions in the specific human *Umwelt* - and the *Umwelt* in general being something that arises by a "projection" on part of the organism. Here lies one basic flaw in von Uexküll's reasoning: it is not possible to take one feature of our *Umwelt* - the organism in question - and hold it outside the constitution, only to let it form the basis for the consecutive construction of its *Umwelt*. The organism is not, of course, able to constitute itself, so two possibilities remain - either the naturalized subject as organism is kept outside constitution (but then it is no longer constitution in a transcendental use of the word, in so far as empirical phenomena (the organism itself as phenomenon) remain unexplained by the constitution), or else the organism was already in an *Umwelt*, namely the scientist's - pushing the constitution one step further back and losing what was gained in naturalization. Here lies a dilemma: either the naturalization of the transcendental subject to organisms is pulled through - or else the constitutive function of the subject is maintained. You cannot have both. A parallel flaw is seen when the Kantian forms of intuition space and time are sought naturalized (otherwise with very interesting consequences, see below): the specific signs of orientation in the *Umwelt* (which in themselves form the elements of a sound theory of biological environment mapping) are taken to constitute time and space *as such*. This analysis is undertaken in the following steps. Organizing signs are distinguished from content signs, so that the former set of signs constitute time and space from more basic sign types: local signs, directional signs, and impulse-to-operation signs (*Wirkzeichen*) respectively. The latter, what we would nowaday probably class under the heading of proprioception and kinaesthetics, even permit us to construct the category of space without any external experience, from the perception of our own body and its

movements only[xii]. But at the same time as all this, we are told that the *Umwelt* is constituted, in turn, by the very *projection* of these signs of time and space onto the organism's outside. But the flaw in von Uexküll's argument is here evident from the fact that "projection" and "outside" are *already* spatio-temporal concepts which may not, then, be tacitly presupposed in a time-and-space constitution theory. So before the organism is supposed to construct space from various *Ordnungszeichen*, it is already itself localized in a surrounding space which it consequently invades and imposes order upon by these signs - hence space is presupposed before this organizing which henceforth may not be said to constitute space as such in any foundational sense of the word, merely in an epistemological sense, relevant only for the specific Umwelt in question[xiii]. Which status von Uexküll ascribes to this common field in which the various *Umwelten* unfold, varies in his work[xiv], but he in any case maintains the inaccessibility of that *Ding-an-sich*-like domain. Yet, in *Theoretische Biologie* we read that

> The material from which a foreign Umwelt is constructed consists in all cases of our objectified quality, because no other qualities at all are accessible to us. The only difference to our Umwelt consists in the fact that they have a lower number. [...] A location which lies more to the left to us than another, lies also in the foreign Umwelt, when both locations are present as perception-signs in them, farther to the left, also when the number of location-perception-signs distinct from one another is less than in our world. [xv]

Even if perceptual granularity (see below) may vary across *Umwelten*, directions are thus preserved in mapping between them. But this invariance constitutes objective space. von Uexküll evidently agrees: to him, objectivity is correlative to spatial determination, but still this determination is strangely seen as subordinated to the overall subjectivism. But if space is not only objective as understood in relation to a specific *Umwelt* but also across *Umwelten*, it ceases to be completely relative to the subject; only the granularity of its construction remains in some sense subjective. This is also evident in von Uexküll's very methodology: we are not supposed to discover other species' *Umwelten* by psychological *Einfühlung*, but precisely by empirical observation of which impulses may be perceived and of which actions they release - comparing these observations with our own *Umwelt*. von Uexküll's contention that the animal *Umwelt* in question must always contain fewer locations than ours is an evident fallacy that may have two

reasons. One is an anthropocentric belief in the extreme perfection of the human *Umwelt* as compared to animal *Umwelten* (hardly probable, given von Uexküll's tendencies towards relativism), the other is a methodological idea that we may only reconstruct in other *Umwelten* what is already in our own. But we may easily observe supersonic hearing or ultraviolet vision in other species, just like we may observe far finer granulations of perceptual space than our own (the sense of smell in many carnivors, e.g.), given the relevant observation and measurement techniques. So the granularity or range of a construed animal *Umwelt* needs not, as claimed, be more gross nor narrow than ours.

　　　　The very objectivity in our construction of other species' *Umwelt* presupposes the possibility of cross-*Umwelt* mappings of at least two kinds. One is identity mapping: the mammal that the tick smells via a molecule of butylic acid is the very same creature as we ascribe completely other perceptual properties (if not, we would not be able to construe the mammal inventory of the tick *Umwelt*). Another is task similarity: being able to specify the functional circles of another species requires that we classify the circle in question in analogy with our own functions (cf. von Uexküll's circle types of food, flight, sex etc.). The first of these mappings requires spatial, indexical invariance (the two *Umwelten* in question shares the same underlying space, even if describing it differently topologically, geometrically, metrically etc.), the second requires semantic, iconic invariance (the two *Umwelten* in question shares functional circles with more or less analogous telos and specific actions)[xvi].

To sum up, there is a constant tension in von Uexküll's naturalized Kantianism, evident in quotes such as

　　　　Every action, therefore, that consists of perception and operation
　　　　imprints its meaning on the meaningless object and thereby makes it
　　　　into a subject-related meaning-carrier in the respective Umwelt
　　　　(subjective universe). (von Uexküll 1982, 31)

At one at the same time, the organism is seen as constitutive of reality as such, on the other, a "meaningless object" - heir to Kant's *an sich* - is supposed to exist out there ("on") *before* these constitutions. But either constitutive subjectivism or naturalized subjectivism without constitutional abilities - you cannot have both. You can not keep your subject and eat it too. Flaws of this kind are inherent in any attempt at naturalizing Kantian

subjectivisms (the arch-example of course being Nietzsche): in Kant, the subject remains transcendental (which raises lots of other problems, to be sure) and this trap is avoided. To us, the choice is easy: naturalized subjectivism must be chosen at the price of constitution - this permits us, on the other hand, unproblematically to accept indexical as well as iconical cross-*Umwelt* mappings.

What may claim to be a "subject"?

Another peculiarity deserves to be mentioned: In von Uexküll's presentation, the predicate "subjective" is often connected to single concrete organisms, so that there is a tendency in the concept of *Umwelt* to be understood as something taking place within the (proto-)mind of the single animal. This tendency might be more dangerous in certain von Uexküll interpreters celebrating the dissolution of the universe in a 'pluriverse' of subjective experiences. But von Uexküll's *Umwelt* construction method takes its departure in objective, spatial qualities characterizing behaviour and consequently does not imply anything about the quality of subjective what-is-it-like-to-be-a-bat experiences. Thus the word "subjective" in von Uexküll's Kantian declaration of faith above should not be conceived in any awareness-consciousness-like use of the word. von Uexküll does not exclude the possibility of a research into this domain - presumably by animal psychologists - but he maintains an objectivist stance as to the biological *Umwelt* reconstruction, even if he now and then comes close to using the predicate "subjective" in a psychological way. Let us here stick to (methodological) anti-psychologism: the decisive feature is the existence of functional circles, just like there is in semiotics, in general, no reason to restrict signs to conscious intentions[xvii]. The methodological principle is stated in *Theoretische Biologie* but is also present in the *Bedeutungslehre*, for instance in the idea that spontaneous reflexes should be included in the semiotic interpretation of the functional circle:

> Even the simple blink-reflex, caused by the eye being approached by a foreign body, does not consist of a mere sequence of physical causes and effects, but of a simplified functional circle, beginning with percepiton and ending with effect.
> That the functional circle, in this case, does not pass through the cerebral cortex, but makes its way through lower centres, changes nothing. (34)

It thus seems perfectly reasonable to speak of the *Umwelt* as the whole set of types of perceptions-reactions - not necessarily conscious - of the animal. At the same time, it also seems - as von Uexküll also in some cases does - reasonable to speak of the *Umwelt* of a whole species ("the tick"). But, having gone so far, is there any reason not, even more generally, to admit the *Umwelt* of more complicated systems like ecologies, corporations, institutions, economies, or the like? If that be the case, then the "meaning" of his *Bedeutungslehre* would cease to be something taking place in a proto-consciousness, but rather be an objective structure defined in relation to sufficiently complex systems (probably what the general theoretical biology of the current Santa Fe school nicknames CASes - complex adaptive systems). In the same movement, von Uexküll's theory will be be cleansed for its tendency towards scepticism, as the *Umwelt* ceases to be a projection due to a subject and becomes instead a self-organizing entity involving an organism and its environment.[xviii]

Meaning as music

Another way of addressing the meaning question in the *Bedeutungslehre* is the idea of the apparent harmony in the incredible fine-tuning between different species' *Umwelten* in ecology. The von Baer musical metaphor for the organism and for biological correspondances in general pervades the whole of the *Bedeutungslehre* and is already present in the *Theoretische Biologie*. There are at least two issues at stake here: the idea of biological perfection and the (more implicit, to be sure) idea of categorical perception. In the *Theoretische Biologie*, a strong emphasis is placed on the perfection of every single species. Darwinism is counterargued by the idea that adaptation implies imperfection being pervasive in nature, and evolution is rejected (or its role, at least, minimized very much) by the idea of the perfect fit between an animal and its environment. In this static idea, a series of problems in von Uexküll's position becomes clear. The perfect fit between animal and *Umwelt* of course requires the static nature of the latter. In a changing world, no perfect fit may a priori be assumed, but rather a continuum of differing degrees of fitting, because environmental change naturally will disturbed established animal-*Umwelt* fits. The idea of a perfect fit has its correlate internally in the functional circle, in so far as it is assumed that, in simple *Umwelten*, to every *Merkmal* corresponds a *Wirkmal* and vice versa. This evidently goes for the tick and species of similarly low

functional complexity, but it seems that as soon as we reach higher animals, a considerable openness of the *Umwelt* softens up the one-to-one mapping between *Wirkmale* and *Merkmale*:

> As soon as body profiles appear as perception-signs, the picture of the perception-world changes thoroughly, for now relative positions in space begin to play a decisive role. [...] Only when spatial differences appear within the perception-sign itself you may talk about a higher stage of perception-world.
> The presupposition for the existence of objects in the perception-world of an animal is provided by the ability of the animal to construct its own functional rules for action. [xix]

The first quote assumes (tacitly, that is) that higher perception worlds become more objective by the introduction of spatial environment mapping; the second connects this higher perception to the possibility of the making up of new functional rules on an ontogenetic time scale, that is, learning. This latter idea in fact connects the objectivity of spatial mapping with the emergence of pure objects (apart from their role in functional circles) and a freedom in action as a result of the tendential dissolution of the very fixed functional circles in lower *Merkwelten*. This remarkable differentiation of *Merkwelt* types reaches its peak in the idea of a specific openness in the human *Umwelt* connected to the appearance of neutral objects. But at the same time, these almost enlightenment ideas run contrary to the dogmatist perfection principle. For it seems difficult to conceive of the invention of new functional circles without assuming some kind of trial-and-error test of them. And the very 'awareness' of neutral objects in an *Umwelt* corresponds to a heightened sensivity for unknown event and dangers - that is, a breaking up of the perfect fitting-in, as well of *Merk-* and *Wirkwelt* respectively, as of functional circle and *Umgebung*, respectively.

So it seems that in von Uexküll's musical metaphor, perfection should rather be left out (as a necessity, not, of course, as a relative possibility). And with it, the Schelling-like idea of the whole of the universe as one harmonious symphony. What is gained, on the other hand, is the ability to act in a changing environment due to general-purpose perception and actions, not tied to specific *Umwelt* functions - improvisation, to include it in the musical metaphor.

But other interesting sides of the musical metaphor remain. In a central example, von Uexküll considers the pea beetle larvae, being born from an egg in a pea, which makes its way to the outside of the pea, only to

drill this tunnel and bite a door in the pea skin while the pea is still soft, so that it later, as a grown-up beetle after metamorphosis, can take advantage of this passage to get out even if the pea is now irreversibly hardened. Furthermore, a certain wasp may take advantage of the existence of this tunnel and lay its egg in the larvae after this tunneling operation, so as to use the larger larvae as food supply for its own larvae, sure to find the same tunnel ready for its exit after having digested its constructor and become a grown-up wasp. Examples like these are impossible by trial-and-error, argues von Uexküll, and he takes recourse to the musical metaphor in order to understand such subtle intercouplings between *Umwelten*. Fine-tunings like this example are examples of a harmony, he rightly claims, and he quotes the famous Goethe stanzas about the pre-established harmony between eye and sun ("War nicht die Auge sonnenhaft ...") in order to depict this harmony.

Thus, the beetle is pea-like and the pea is beetle-like in this Goethean reciprocity (and both presumably wasp-like etc.); the whole of nature is fused together with meanings of this kind where *Umwelten* marvellously fit each other locally. While the naturalised subjectivism tends to make it impossible to see beyond the horizon of the *Umwelt*, the musical metaphor makes possible an inference to mend this problem: the reciprocity of *Umwelt* meanings is made possible by the composer of nature's symphony, presumably a Mozartian god whose hands interchangeably plays over the claviature of nature's possibilities during the course of earthly time. Even if any evolutionist must immediately reject this far-stretched creationism, there remains something of the Goethean harmony picture even if we secularize von Uexküll's vision and grant evolution its rightful role as the "creator" of these harmonies. There remains, namely, a gestaltist and hence non-irrational account of the organization of the life of an organism. In a through-and-through vitalist as Hans Driesch, we find the interesting idea that the entelechy, the organizing principle, emerges out of an 'ultra-dimension' in addition to the physical constraints in space and time. But this dimension needs not be the refuge of unknown forces. The melody - arch-example for the Gestalt Theorists from von Ehrenfels, Stumpf and the early Husserl onwards to the Berlin and Graz schools - articulates an organized structure disconnected from the here-and-now of physics and implying a teleological circle foreseeing the last note already by the intonation of the first. Thus - as Merleau-Ponty remarks[xx] - this metaphor makes it possible to see the life of the individual organism as a realisation, a variation of the theme, requiring no outside vitalist goal - a variation, we may add, that

forms the condition of possibility of the modification of the animal's system of functional circles and hence the acquiring of new habits, possibly to govern evolutionary selection in Baldwinian evolution. Here, the lucky possibilities of Uexküll's melody metaphor goes beyond his own static perfections intentions: music may be perfect, but it is far from always the case. Sometimes only dissonant tuning of the instruments may be heard, in other cases false breaks during a melody or more or less successful new variations on a theme; in any case, evolution as a whole might be a symphony, but only if it is one of continuous improvisation.

But there is even more to be gained from that metaphor. We may ask: what are the means used by nature in harmony - of course reconceived in an evolutionary perspective rather than in von Uexküll's religious vitalism?

Categorical perception

Let us take a closer look at some of the implications in von Uexküll's musical metaphor:

> We know from Sarris's experiments that a dog trained to the command 'chair' learns to sit on a chair, and will be on the look-out for other seating-accommodations if the chair is removed; indeed, he searches for canine sitting-accommodations, which need in no way be suitable for human use.
>
> The various sitting-accommodations all have the same 'sitting-quality' (*Sitz-Ton*); they are meaning-carriers for sitting because they can be exchanged with each other at will, and the dog will make use of them indiscriminately upon hearing the command 'chair'.
>
> Therefore, if we make the dog a house-occupant, we will be able to establish that many things will have a 'sitting-quality' for the dog. A great number of things will also exist that will have an 'eating-quality' (*Fress-Ton*), or a 'drinking-quality' (*Trink-Ton*) for the dog. The staircase certainly has a 'climbing-quality' (*Kletter-Ton*). The majority of the furniture, however, only has an 'obstacle-quality' (*Hindernis-Ton*) for the dog - especially the doors and cupboards, which may contain books or washing. All of the small household effects, such as spoons, forks, matches, etc. do not exist for the dog because they are not meaning-carriers. (von Uexküll 1982, 29)

There are several interesting lessons to be learnt from this quote. One, central, is that the musical metaphor pervasive in von Uexküll's

Bedeutungslehre has the further virtue of permitting him to talk about categorization in meaning without explicitly mentioning it, taking us to the issue of categorical perception already touched upon in ch. 9. It is by now well known that music listening involves categorical perception so that a small frequency environment around a pure tone is heard as that tone, while the frequences beyond a certain limit is heard as false tones, until the next frequency window around a pure tone (depending on the scale chosen, to be sure) appears[xxi]. Thus, the tonal system constitutes a discontinuous categorization of the continuum of frequencies. This fact now permits von Uexküll to use music as a metaphor for biological meaning. All the examples in the quote discuss how the animal ascribes a certain tone to a range of different but comparable phenomena, that is, categorizes them. Edible stuff is categorized, just like drinkable, climbable, unsurpassable etc. stuff. Thus, it seems a crucial but not explicitly admitted fact in von Uexküll's picture of biological nature as a symphony that this harmony is achieved by means of categorical perception. When the moth hears the bat's supersonic echo-signaling sound (which is the only frequency its ear is able to registrate), then the very anatomy of the ear performs the categorization task just like the case with the tick's extremely restricted and precise sense of smell. The same goes for the pea/pea beetle/wasp example: the pea beetle must be able to categorize pea plants in contrast to all other herbs in order to find a place for its eggs precisely there - and more so with the wasp which has to make a specific subcategory out of those peas having already had a pea beetle visit[xxii].

The concept of categorical perception has its origin in psychological linguistics and its research in phonetics: how is it possible that human speakers immediately recognize discrete phonological categories in the phonetic continuum? Only by means of categorical perception, weakening the distinction ability inside a phoneme category and correlatively strengthening the distincion ability across category boundaries[xxiii]. In the same way we must suppose that the dog obeying the "chair" imperative follows a categorization of 'sittable' objects, and it must be assumed that this category is subject to a version of the same basic weakening and strengthening constraints as in human categorical perception. von Uexküll almost explicitly admits the first of these constraints when he says about the single 'dog chairs' that they "... can be exchanged with each other at will". Thus I would argue that the whole *Umwelt* biosemiotics should be reconstructed in terms of categorical perception (CP). Now, it is long since admitted that higher animals perform categorical perception[xxiv] but von

Uexküll's claim that even single cell animals possess functional circles takes categorical perception back to a much more primitive level of biology. In the previous chapter, we argued that the primitive biological cases of categorical perception points to the fact that the procedure must have stereochemical prerequisites already in biochemistry, and von Uexküll's *Bedeutungslehre* points in the same direction in so far as the meaning circle is assumed to take place in simple reflex processes already and hence must have a basis in relatively simple physiology.

On the other hand, von Uexküll's favorite example leads him to draw too simplistic implications from the seemingly omnipresence of meaning circles (and correspondingly, categorical perception) among animals. His tendency to privilege the stimulus-response-like character of the simpler *Umwelten* which couples one *Merkmal* with one behaviour (most examples are from relatively lower animals, and the definition of meaning circle maps *Merk- and Wirkmale* one-to-one ...) underestimates the openness he admits in higher animals' *Umwelten*. This as a consequence makes it difficult to tell the single object categorized from the category that subsumes it. This idea corresponds to an early mistake in categorical perception studies, that the weakened distinguishibility inside a category should be interpreted as a total lack of inside-category distinctions. Thus, it was supposed that all /b/s are heard as /b/s with no sensibility for dialect, personal or other variations. This idea has long since been given up in categorical perception research, and the same ought to be the case in *Umwelt* biosemiotics. Thus, von Uexkülls late contention that animals can not perceive neutral objects (in categorcial perception terms: that it is unable to distinguish properties in it apart from the properties giving rise to its categorization) is dubious (and runs counter to his more open stance in *Theoretical Biology*, see above):

> The unsatisfactory result of this work [American rats-in-a-labyrinth research], despite the most exact techniques of measurement and their most refined mathematical treatment, could have been predicted, because it was based on the false assumption that an animal can at any time enter into relationship with a neutral object. (27)

But it is noteworthy that Uexküll himself, in the dog example quoted above, considers the *Hindernis-Ton* of certain mesoscopic objects in the dog *Umwelt* at the same time as he claims that all objects perceived in an *Umwelt* must form part of specific functional circles. But obstacles are not part of any specific functional circle, be it sex, food, water or other circles, but of a more unspecific and open-ended environment mapping loosened from

immediate functional utility. Moreover, the general fact that higher animals may not only be fooled but may themselves discover the fooling points to the fact that they do have the competence for distinguishing different instances of a perceived category, that is, distinguishing objects with respect to properties neutral to a given perceptual category. It is hard to see that this is not exactly what perception of neutral objects is about. There is any reason to believe that higher animals thus master the plural grasping of one and the same object by several simultaneous representations, that is, at least both as types and tokens, and possibly also as symbols for some other type (all three are assumably present in as simple a case as the classic Pavlov conditioning: different bell sounds are categorized as one and the same ringing type, all, in turn, symbolizing general eating). One of the central categorical perception researchers, Stevan Harnad, in his conclusive paper in his state-of-the-art *Categorical Perception* anthology, outlines a three-level categorical perception theory built from exactly these three layers: a continuous, pre-categorization representation; a discontinuous categorization, typification, still on the perceptual level; and finally the possible symbolizing of the perceptual types (for instance as linguistic labeling)[xxv].

Thus, in higher animals the categorical perception in the meaning circle has considerably vaster complexity and variability than in the moth-bat sound case, and the former case is probably much closer to the extreme variability and extrapolability of the human *Umwelt* than to the latter reflex-like relation. If this is the case, then von Uexküll's sharp distinction between animal *Umwelten* and the human *Umwelt* must also be given up. Of course there are crucial differences between the two but it is not the case as von Uexküll in the *Bedeutungslehre* seems to assume, that all animal *Umwelten* are equally closed in contrast to a specific human openness[xxvi]; if this idea is given up, the higher animals' more sophisticated *Umwelten* may be placed on a scale making the evolution of the extreme plasticity of the human *Umwelt* understandable.[xxvii]

To return to von Uexküll's musical metaphor, there is much in it that can easily be subscribed to: the condition of possibility for nature to link up in these strange 'harmonies' between different species' *Umwelten* depends precisely on categorical perception: the perceptual categories form the tones in the metaphor, and it is their categoricity only that permits them to enter into counterpoint between the single *Umwelten*. The fact that different species may entertain the Goethean likeness-relationship between each other

must be due to the reciprocal fitting in of categorical perceptions of their *Umwelte* - only in this can this apparently mysterious likeness consist.

But it is interesting to note that the categorical perception implicit in the *Bedeutungslehre*'s melody metaphor has got some important theoretical underpinnings in the earlier *Theoretical Biology*. That book begins with a presentation of space and time in the naturalized Kantianism we quoted in the beginning. We have already dealt with the problematic assumptions in the foundations of this idea, but if we turn to the formal description of the very mappings of space and time, more interesting observations show up. Both space and time are subject to a crucial granulation in the *Umwelt* construction. *Umwelt* space is constructed - unlike Euclidean geometry - from localities, from *Orte*, just like *Umwelt* time is constituted not from timeless nows, but from short time bits, from *Momente*. The size of these *Umwelt* building blocks is of course relative to the senses and the inner life of the animal in question, respectively. But this implies that the perception and action systems of an *Umwelt* imposes on the surroundings a granularity (the smallest *Ort* in human beings is palpable by the fingertips and visible at close range; the smallest *Moment* the one eighteenth of a second corresponding to the number of pictures per second for movies not to blink). The same is the case for the *Inhaltszeichen* filling shorter and larger chunks of time and space where the ability to distinguish implies a least color (resp. tone) unity. These distinction sensivities in space, time and quality, correlative to the perception systems in question, become the condition of possibility for more advanced categorization tasks to be fulfilled. They are performed, now, by *schemata*. In his insistence on this figure in the *Theoretische Biologie*, von Uexküll makes his place clear in the ranks of diagram semioticians. He is especially interested (in contrast to Kant) in empirical schemas, so as for instance object contours making it possible to recognize objects. Such contours are described as "melodies" comprising many orientations-signs, and

> By this process, the melody of the orientation-signs is the gestalting power which, however, only reaches consciousness in the "gestalt". The gestalting melody Kant called a "schema", and the hidden art of gestalting in our mind he called the "schematism".[xxviii]

Melodies in this general sense - that is, diagrams - and qualities are what is needed to build the objects of the *Umwelt;* and as the melody metaphor suggests, the schemata may depict spatial (e.g. familiar faces) as well as

temporal (e.g. a sequence of movements) regularities. It goes - in von Uexküll - without saying that schemata must be subject to the same granularity as time, space, and qualities (being built from these), and in our Peircean notions we will not hesitate to say that diagram types must be distinguished from diagram tokens and that it is precisely the schematism types that make it possible to use the diagram to categorize a series of individual but related phenomena. von Uexküll places perceptual schemas as crucial to the feed-back control of motor action in higher animals (but does not, strangely, see the action's impulse series as a schema itself), so that sufficiently complicated action must be assumed impossible without implying schemata – organizing general diagrams.

The introduction of schemata fulfills the semiotic prerequisites for the meaning circle: a *Merkzeichen* may refer to a *Merkmal*, but also further on to a *Wirkmal*, a *Wirkzeichen* and a *Wirken*. Thus, the "meaning" in the meaning circle may be located in many different places, according to which phase of the circuit the attention is directed. The smell of a deer may mean prey to a lion, it may mean the thought of hunt, it may mean bodily preparing for hunt, it may mean the hunt itself. The sight of other lions preparing for hunt may similarly mean deer, prey, hunt - as well as, according to other meaning circles, competition for meat etc. Any part of the schema governing a functional circle may meaningfully refer to any other part of the same circle: this is where primitive signification lies in the meaning circle, and the reason why it gives rise to proto-signs[xxix]. If we successfully subject sensory material to e.g. our soccer ball schema or 'melody', then this *Merkzeichen* may refer to a ball, to a kick, to the feeling of a kick or to a performance of a kick ... In return, the success of this *Wirken* may now be measured on bodily and mental schemata of a good kick ... As soon as the neutral objects permitted in *Theoretische Biologie* (but not later on in the *Bedeutungslehre)* show up, furthermore, the possibility of applying different schemata on the same sensory material appears, thereby interpreting it merely symbolically, that is experimentally: the ball seen as a globe, as an egg, as a sphere etc. The semiotic strength of the coupling of category schemata with the functional circle is that the epistemological requirements of the first and the pragmatic requirements of the latter become equally responsible for the categorization inherent in the *Umwelt* construction.

But which kinds of categorical perception are at stake in this concert? A certain amount of confusion has plagued categorical perception research as to the very definition of its categories. Are they defined by the

boundaries, distinguishing one category from the other, are they rather defined by the single category's prototype (which may again be defined by different means: typical, ideal, average etc.), or are they defined with regard to earlier encounters with category exemplars? The idea that one of these definitions should outrule the others seems to be on the way to be given up in favour of a recognition that all of them are mechanisms used to different degrees in various categorization tasks. In any case, these different procedures can be collected under the headline of "reference points" as a common denominator for boundaries, stereotypes, prototypes, ideals etc. Similarly, as Medin and Barsalou emphasize (in Harnad 1987), there may be different patterns of sensitivity so that some categorizations or tasks may display heightened sensitivity around prototypes, while others may display lowered sensitivity around them (477). A crucial difference goes between boundary reference and the various prototype references, and one of their suggestions is that

> Perhaps one difference is that reference points are more likely to occur at the boundaries of SP [sensory perception] categories than at the boundaries of GK [generic knowledge] categories. To some extent this may reflect greater innate constraints on SP categories than on GK categories. (475, my brackets)

and that boundary categorization is tendentially more relevant for discrimination tasks (like: is this sound a /p/ or a /b/?) while prototype categorization is more relevant for classification tasks (like: is this animal a predator?).[xxx] If this is correct, we should expect biosemiotic categorical perception to display both, but maybe with a tendency to favor the prototype sort (classification is biologically more basic than discrimination). Uexküll's simplest examples (the tick, the moth) are so simple that they are difficult to determine with respect to the boundary/prototype distinction. Of course the auditory sensivity of the moth has a lower and a higher boundary, but the animal does not in any way distinguish between what is on either side of it (it simply cannot hear what is beyond it); it would probably be more fair to call it a case of prototypical categorical perception. If the moth's sensibility window is larger than the average bat frequenzy range - which sounds probable - then we could see it as a simple case of prototypicality. A well-known case of innate ideal reference point is the so-called supranormal releasers which refer to facts like that new-born seagulls accepts objects of a certain coloring and form (like a beak) as their mother - but the color-form

configuration which has the strongest impact on them are different from any empirical seagull and hence forms an ideal reference point of their "mother" category. Boundary categorization (which of course may appear together with prototypicality in one and the same category) should be expected where there is a crucial behavioral difference in relation to the two categories on each side of the border, that is, it should be expected in unidimensional gradients where a continuous change leads to ethological difference (behavior difference occuring at a temperature threshold, for instance), or when more complex but very similar categories give rise to different behaviors (similar berries, the one being edible, the other poisonous). Thus, we can imagine perfectly naturally occurring "pure" cases of boundary CP where no typicality attractor needs be present in the center of the categories, just as we can imagine "pure" cases of prototype CP where the boundaries are fuzzy or simply do not exist (what are the boundaries of phenomena like "danger" ...). The more specific musings on these issues must be left to further empirical research, but the point is probably clear on the principal level discussed here: both main types of CP are present already on rather primitive biosemiotic levels and reflect at least a double (icon-token/icon-type) or rather a triple information (icon-token/icon-type/symbol) procedure at stake.

Categorical perception as a general semiotic notion

Thus, a closer analysis of a contemporary version of von Uexküll's *Umwelt* forces us to acknowledge categorical perception as a primitive notion in semiotics. But if it be so, then semiotics ought to attempt a reformulation of the originally psychological CP concept in non-psychological terms. The occurrence of categorical perception in both human and animal psychologies seems sufficient evidence for it to be a formal notion not only with psychological relevance. In the previous chapter, we tried to trace the prerequisites of CP in (bio-)chemistry, but one could also point to its possible relevance for other complex organism-like systems with highly selective environment relations (institutions, ecologies, economies, social groups, etc.)[xxxi]. A provisional attempt at a formal definition could be: *Categorical Perception is the granularity of Umwelt for a complicated system*. The overall reason for such a granularity (each grain giving rise to a CP) would be economy in environment relations permitting cognition. Or rather, the economy in environment relations *is* cognition, or vice versa. If so, CP is a semiotic piece of formal ontology and should be brought in

correspondence with the actual strivings in formal ontology at generalizing von Uexküll's *Umwelt* notion; cf. Barry Smith's idea of the *niche* as a general category in formal ontology discussed earlier. It seems a defining feature of a Complex Adaptive System that it must entertain Categorical Perception in relation to its niche so that certain types of niche stimuli evokes highly specific regulatory actions in the Complex Adaptive System, and that certain stimuli are even able to change the CAS's niche relations in general (this would be the formal notion of adaptation).

If this be the case, then this formal conclusion will allow us to draw one further implication for biosemiotics. We have already ridiculed von Uexküll's ardent anti-evolutionism and his support to an irrationalist vitalism or creationism, and an updated version of the *Umwelt* must of course embed it in an overall evolutionary framework. Still, in the Categorical Perception reading of the *Umwelt*, it contains a more delimited and more precise arguments against certain assumptions in the Neo-Darwinist doxa, namely the idea that all order in nature is the result of natural selection. As a primitive order notion, CP in its formal version seems to be a necessary *prerequisite* for life as such, rather than being a contingent result of selection[xxxii]. Thus, it constitutes a germ of order which may not be the result solely of natural selection. Rather, natural selection seems to presuppose CP in order to have orderly alternatives from which to select. In so far, the general biosemiotic CP notion supports Stuart Kauffman's claim that biological order is no product of natural selection, rather natural selection determines which specific order among many suits a certain environment best.

Thus, to conclude, our reconstruction of the *Umwelt* concept places it as central to theoretical biology and biosemiotics in particular and to semiotics and formal ontology in general. This only happens, of course, on the basis of a thoroughgoing revision of the concept, depriving it from its subjectivist, skepticist and anti-adaptionist flaws in von Uexküll's version. It must be cleansed for all traces of radical constructivism in favour of a moderate, realist constructivism: each species constructs its own *Umwelt* all right, but it takes place in a common world which is not in itself a construction. In so far, this moderate, realist construction is hardly distinguishable from self-organization. If nature is indeed a symphony, we must not expect of it the perfection read off the final score. We should rather see it as continuous rehearsals and improvisations without composers nor directors which nonetheless results in stunning performances and the continuous invention of melodies and harmonies as well as scales. The

contribution of von Uexküll's *Bedeutungslehre* to our days' semiotics, then, is to provide the outline of a rational analysis of the alamodic notion of "embodiment" in terms of a schematically supported functional circle, thereby indicating the biological roots of meaning as connected to such schemata, or, in the ever resounding musical metaphor, melodies.

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[i] A lineage involving scholars like Goethe, Geoffroy Saint-Hilaire, von Baer, d'Arcy Thompson, Spemann, Driesch, Waddington, Brian Goodwin, René Thom, Robert Rosen, Stuart Kauffman, inter alia.

[ii] René Thom has attempted to rescue the term vitalism, claiming that it is reductionism which is a dogmatist view, trying to repudiate the reality of the organism, evident for all to see. His insistence on the term, however, does not include the usual assumptions of the existence of extra-physical forces or the like, so his idea of saving the term, however sympathetical, should probably be left behind. Nevertheless, in this connection he makes a surprising attack on Neo-Darwinism, hinted at above: it is Neo-Darwinism which is the metaphysical theory, not at all so empiricist as it often sees itself, and what is more, in contrast to the epigenetic tradition's emphasis on ontogenesis, the Neo-Darwinist emphasis on phylogenesis gives it a *holism* on the species level, contrary to its own reductionist claims, in so far as it is the genome of a species which is considered the main object of research. (Thom 1990, p. 600)

[iii] "Umwelt" is often quoted as von Uexküll's own terminological neologism; in fact, it was already used by Goethe and originates from the Danish-German Enlightenment-Early Romanticism poet Jens Baggesen who coined it in an ode to Napoleon in the year 1800.

[iv] cf. von Uexküll 1973, p. 220.

[v] The inclusion of von Uexküll in the current repertoire of semiotics is thus largely due to Sebeok. But despite his exile status in relation to biology departments, there is a series of other local "rediscoveries". Most notably, probably, his status as ancestor to present-day ethology via Lorenz and Tinbergen. But also his role in the biological parts of Cassirer's theory of knowledge should be mentioned (Cassirer (1991) quotes with approval the "nicht-stoffliche Ordnung" of the *Theoretische Biologie* as a central concept for an anti-vitalist biology - see Stjernfelt (forthcoming) b), in René Thom's catastrophe theory (1977, 1990) with his insistence of the centripetal vs. centrifugal construction principles of machines and organisms, respectively (despite the non-mechanist teleology inherent in both), and, most elaborated, in Merleau-Ponty of around 1957-60: in his lecture notes for that period (1995), dealing with the concept of nature, we find a large chapter on the phenomenological importance of the *Umwelt* concept: its introduction of "plans naturels" making possible the "commencement de culture" and its gradual evolution, being "moins en moins orienté vers un but et, de plus en plus, interprétation de symboles." (231) – see ch. 10. Finally, the "embodiment" wave of recent cognitive studies also display a growing von Uexküll interest.

[vi] The illustration is from von Uexküll 1973, 105. Such circles are most often, in von Uexküll, connected to individual purposes of the organism: drinking, preying, eating,

mating, fighting, etc. Collective functional circles of more complex kind, relevant to a flock or herd Umwelt must be presupposed in the semiotically interesting cases of social animals; we shall not go into this issue here.

vii A Kantian idea, to be sure, prefigured in Kant's idea of causal circles in "Kritik der teleologischen Urteilskraft" – see the previous chapter.

viii This goes for animals, even down to unicellular animals, but not for plants in so far they are generally seen as possessing a truncated *Umwelt* all right (von Uexküll calls it a *Wohnhülle*, a dwelling place), but no functional circle because of their stationary life and lack of nervous system, making them unable to move and hence unable to perform *Wirken*. This distinction seems somewhat problematic (heliotropes or carnivorous plants e.g. seem to form spectacular exceptions and not the only ones) but we shall leave further discussion of it here.

ix Example given by several occasions, e.g. von Uexküll 1973 1982, p. 56-57.

x Prominent figures in a Neo-Kantian semiotic family tree would include Peirce, Cassirer, and in our days Jean Petitot and the American cognitive semantics traditions; the differentia specifica will be the assignment of a central role to schemas or schema-like concepts in the respective semiotic theory. For a discussion of Neo-Kantian semiotics and Peirce, Cassirer, and Heidegger, see Stjernfelt 1999b and 1997. Taken in a more wide sense, of course, Neo-Kantianism as meaning merely semiotic reflections inspired by Kant, it would include the doctrines of Nietzsche, Heidegger, brands of *Lebensphilosophie* as well as evolutionary epistemology.

xi The German quote can be found in von Uexküll 1973, p. 9.

xii This attempt at the organism's auto-constitution of space, however, is mysterious: a single segment of the (in itself spatially defined) functional circle is taken to be constitutive of space ... So the same problem remains here: if the organism is taken to be a subject in the constitutive sense of the word, then it is posited anterior to time and space, and its body remains part of the empirical world just like any other object - if the organism, on the other hand, is taken to be the empirical animal, then its bodily sensations are seminal to the construction of its surrounding space-time - but not of space-time as such.

xiii The same is the case in von Uexküll's famous tick example. The tick *Umwelt* as it is described here, has little to do with the simplicity we must suppose pertains to the real tick *Umwelt* but is ripe with concepts from the scientist's *Umwelt*: the branch, the fall, the mammal etc.; and the example lives from our intuitive grasping of a mapping from the scientist's *Umwelt* to the tick *Umwelt* and back. But this mapping presupposes a space in which both these *Umwelten* partially coincide, namely an objective space from which scientist and tick *Umwelt* select each their sets of relevant signs. If no such space is supposed, the mapping between scientist and tick *Umwelt* can not be presupposed, and the *Umwelt* hypothesis will fall (consequently, the idea of an ontological 'pluriverse' of *Umwelten* is contradictory).

xiv Merleau-Ponty finds a development in von Uexküll from an early Kantianism in which the *Umgebung* behind the various *Umwelten* plays the role as Ding-an-sich and to a later Schellingianism, in which Nature becomes a name for the integration of all *Umwelten*. (Merleau-Ponty 1995, p. 232)

xv Translations from *Theoretische Biologie* are mine. "Das Material, aus dem sich eine fremde Umwelt aufbaut, besteht unter allen Umständen aus unserer objektivierten Qualität, weil uns andere Qualitäten gar nicht zugänglich sind. Das einzige Unterschied zu unserer Umwelt besteht darin, dass sie geringer an Zahl sind. [...] Ein Ort, der für uns mehr nach links liegt als ein anderer, liegt auch in der fremden Umwelt, wenn beide Orte als Merkmale in ihr vorhanden sind, ebenfalls weiter nach links, auch wenn die Anzahl von örtlichen Merkmalen die sie voneinander trennen, geringer ist als in unserer Welt." (von Uexküll 1973, 104)

xvi An analogous argument as to the possibility of inter-species *Umwelt* mappings due to "general-purpose sensory and effector mechanisms" can be found in Cariani 1998, p. 252-3. The possibility of mappings within and between different functional circles in the same species must is in itself count as a core contribution to the semiotic generativity in higher animals and humans especially: they constitute metaphors, blendings, metonymies etc. and thus form part of the biological basis of cognitive semantics' "literary mind", cf. Turner 1996.

xvii This does not, of course, rule out the issue of the experienced qualia consciousness and its "inside". It is perfectly possible, even highly probabale, that higher animals (that is, animals possessing a central nervous system) entertain inner states of this kind, and the question whether lower animals or even plants share related properties remains undecided. Yet, this question must be kept apart from the functional *Umwelt* definition, because the existence of a functional *Umwelt* in a species does not imply the presence of qualia consciousness. As to research into the qualia consciousness issue, however, we have not, at present, any scientifically valid method to ascertain nor investigate such states.

xviii Thus it will no longer be the case, as von Uexküll quotes the radical conservative sociologist Werner Sombart: "No 'forest' exists as an objectively prescribed environment. There exists only a forester-, hunter-, botanist-, walker, nature-enthusiast-, wood gatherer-, berry-picker- and a fairytale-forest in which Hansel and Gretel lose their way." (29). The fact that the forest is defined exactly with reference to these and related groups (and not e.g. football players, state secretaries, unemployed, Irishmen, or other collective subjects) is an objective fact which we - so Sombart - are able to registrate and which thus forms part of the characterization of the forest, not its dissolution. The Nietzschean skepticism in this quote is related to other radical conservative and irrationalist vitalist features in von Uexküll, for instance his pessimism toward civilization, not to mention his Nazist leanings.

xix "Sobald die Umrisse der Körper als Merkmale auftreten, ändert sich das Bild der Merkwelt von Grund aus, denn nun beginnt das Nebeneinander im Raum eine ausschlaggebende Rolle zu spielen. [...] Erst wenn räumliche Unterschiede im Merkmal selbst auftreten, kann man von einer höheren Stufe der Merkwelt sprechen." (189) "Voraussetzung für die Existenz von Gegenständen in der Merkwelt eines Tieres bildet die Fähigkeit des Tieres, eigene Funktionsregel für sein Handeln zu bilden." (191)

xx "Bref, c'est la thème de mélodie, beaucoup plus que l'idée d'une nature-sujet ou d'une chose supra-sensible qui exprime le mieux l'intuition de l'animal selon Uexküll. Le sujet animal est sa réalisation, trans-spatiale et trans-temporelle. Le thème de la mélodie

animale n'est pas en dehors de sa réalisation manifeste, c'est un thématisme variable que l'animal ne cherche pas à réaliser par la copie d'un modèle, mais qui hante ses réalisations particulières, sans que ces thèmes soient le but de l'organisme." (Merleau-Ponty 1995, p. 233)

[xxi] Probably the ability to distinguish pure from false tones (relative to a given scale) is innate in humans: already 4-months old babies express disgust when faced with false tones (Wilson 1998, p. 166).

[xxii] The place of these categorical perception examples in functional circles even anticipates a central issue in the recent decades' category research: Eleanor Rosch's observation that there is a "basic level" of categorization relevant to corresponding basic motor routines involving those objects. Functional circle categorical perception is defined with respect to the *Wirken* and hence on a motor routine basic level.

[xxiii] The categorical perception tradition in cognitive psychology has its roots in phonetics but has since then spread onto other senses (e.g. color perception) and species (higher animals categorical perception). In Stevan Harnad's central 1987 anthology around the subject, most papers still focus upon perception issues, but one seminal paper (Medin and Barsalou) undertakes a detailed comparison of categorical perception research with semantic categorization and finds much more similarities than expected. Many brands of structuralism tacitly assume the same parallel (e.g. in Hjelmslev's thoroughgoing formal parallelism between expression and content). The same continuity between perceptive and semantic categorization is often tacitly assumed in the cognitive linguistics and cognitive semantics traditions in the recent decades. Categorical perception in the Uexküllian *Umwelt* connection is a strong argument for this continuity to the extent that the perceptual categorizations in primitive animals are directly linked to semantic categorizations (namely of the corresponding *Wirkmale*, specific actions). Thus, we here immediately use the categorical perception concept about animal categorization. Generally, no sharp distinction seems to delimit perceptual and semantical categories which rather form parts of a continuum.

[xxiv] Cf. Günter Ehret and Patricia K. Kuhl in ch. 10 and 12, resp., in Harnad 1987.

[xxv] It is striking how much Harnad's model mirrors features in Peirce's classical account for the generality of signs, where token and type denotes the particularity and generality of the sign itself, while the type due to its typicality in turn may be used as a symbol to signify some other general object.

[xxvi] von Uexküll even, in a *lebensphilosophical* gesture typical for his time, makes the specificity of the human *Umwelt* a tragic problem for our species. It is strange that he can, on the one hand, claim that his theory of meaning "culminates in explicating this connection" (the relation between a human need and the corresponding utensilia, such as coffee and coffee-cup), at the same time as he on the other hand can state that "It should suffice to point out that with all our utensils we have built bridges between ourselves and nature. In so doing, we have come no closer to nature; in fact we have removed ourselves from her. [...] In the city we are exclusively surrounded by artifacts [...] The much-lauded technology has lost all feeling for nature: Indeed, it presumes to solve the most profound questions of life - such as the relationship between man and god-like nature - with totally inadequate mathematics." (66-67) It is by no means an evident corollary to his theory that

man should possess this tragic distance to nature; quite on the contrary. If Uexküll's concepts are removed from his creationism and *lebensphilosophische* pessimism of culture, it may be integrated into evolutionism such that man's especially malleable *Umwelt* becomes a consequence of the ever more complex *Umwelten* of higher animals, cf. Jesper Hoffmeyer's idea of a gradient of growing "semiotic freedom" during evolution.

xxvii Even if the *Bedeutungslehre* is sceptical against neutral objects in animal functional circles, it admits the possibility of distinguishing properties in the object with greater or lesser relevance for the animal. This, Uexküll argues, is what gives rise to the Aristotelian essentia/accidentia distinction, referring to a rank-ordering of properties by importance according to the functional circle in question (p. 28). This distinction may receive a formal interpretation in the light of categorical perception, implying the crucial strengthening of cross-boundary distinctions (relevant for the essentia) as well as the weakening of the intra-boundary properties (which are hence accidental, according to the categorization in question).

xxviii "Bei diesem Vorgang ist die Melodie der Richtungszeichen das Gestaltende, die uns aber nur in der "Gestalt" zum Bewusstsein kommt. Die gestaltende Melodie nannte Kant *ein "Schema"*, und die verborgene Kunst des Gestaltens in unserem Gemüt nannte er den "Schematismus"." (118)

xxix Here, we disagree with Chebanov's otherwise exciting paper (1999) and its claims that the concept of *Umwelt* does not entail semiosis. A similar discussion which we mentioned earlier was raised at the conference World and Mind in Copenhagen May 2005 where the British philosopher Galen Strawson argued against the existence of non-conscious intentionality from a so-called "stopping problem". If we take the causal chain involved in a perception or other intention, then the intention selects its object in that chain. Not so for non-conscious processes, Strawson argued: here the object intented can not be distinguished from other segments of the chain such as the light falling upon the object or my retina or my visual cortex. Obviously, it would be absurd to say that I see my neurons working in my visual cortex. When consciousness is absent as stopping criterion, so Strawson, there is no criterion for determining the object of intention and hence not for intentionality at all. Strawson's argument begs the question, however, in presupposing intention to be translatable into a causal chain which is, of course, not intentional. If intention, in an Uexküllian manner, is defined by the functional circle, any further segment of that circle is functionally intented. Even if microscopically continuous, the perception and action signs cut up the circle in characteristic schematic segments, due to granularity, and in the circle, a segment may serve as a sign for a later segment. Butylic acid serves as a sign for falling, serving as a sign for warm skin (or for crawling back on a branch), serving as a sign for biting ... Thus, the stopping problem is posed in a wrong way as pertaining to linear rays of intention. It overlooks that such lines basically constitute segments of the functional meaning circle – what is intended is intended with respect to its virtual inclusion in this circle.

xxx Here, we recognize two different sets of semiotic oppositions: contrary and contradictory relations (in e.g. Greimas) vs. marked/unmarked (Jakobson), the former privileging boundaries over prototypes, the latter prototypes over boundaries.

xxxi Niklas Luhmann's autopoiesis theory seems to be an attempt at generalizing this insight in sociology, seeing societies as consisting of systems with each their defined *Umwelten*.

xxxii Thus, the centrality of some version of CP in any functional circle definition points to it as being a formal a priori prerequisite of biosemiotics - adding to the arguments connecting biosemiotics to formal ontology in ch.9.