

# Introduction: The sign theory of Jakob von Uexküll\*

THURE VON UEXKÜLL

## 1. Personal history and field of research

Jakob von Uexküll was born in Keblas, Estonia in 1864. After completing his studies in zoology at Dorpat (now Tartu, Estonia) he worked at the Institute of Physiology of the University of Heidelberg and at the Zoological Center in Naples. In 1907 he was given an honorary doctorate by the University of Heidelberg for his studies in the field of muscular physiology. His later work was devoted to the problem of how living beings subjectively perceive their environment and how this perception determines their behavior. He developed a specific method which he termed 'Umwelt-research'. In 1926 Uexküll founded the Institute of Umwelt-Research at the University of Hamburg. He died on the island of Capri, Italy in 1944.

Uexküll's field of research was the behavior of living organisms and their interaction as cells and organs in the body or as subjects within families, groups, and communities. He is recognized as one of the founders of behavioral physiology (ethology) later to be further developed, notably by Lorenz and Tinbergen.<sup>1</sup>

Of particular interest to Uexküll was the fact that signs are of prime importance in all aspects of life processes. He developed an original and integrated theory of sign processes, which was, however — and still is — open to misinterpretation, since it cannot be classed among any of the established sciences. Thus it concerns itself neither with physiology — even behavioral physiology, although the latter comes close to his theory in many aspects — nor with psychology, although subjects and their perceptual and behavioral activities are of central importance to it. Moreover, it cannot be placed within those boundaries which separate the

\* Originally published as 'The sign theory of Jakob von Uexküll'. In *Classics of Semiotics*, M. Krampen et al. (eds.), 147–179. New York: Plenum, 1987. Reprinted by permission of the publisher.

human sciences (*Geisteswissenschaften*) from the natural sciences (*Naturwissenschaften*). Uexküll himself referred to his field of research as 'biology', though he did not use the term in the narrowly defined sense applied to it today, but understood it as the science of the life of plants, animals, and human beings. Many misinterpretations can be overcome if his theory is classified as 'general semiotics'. Yet at the same time it becomes obvious that general semiotics also falls into an area between the boundaries of the established disciplines. A science which embraces the natural sign systems alongside and before the human sign systems we call 'language' must at the same time break down the traditional division between the human sciences and the natural sciences. However, the attempt to classify Jakob von Uexküll's theory as general semiotics also presents us with some difficulties. As he knew neither Peirce nor Saussure and did not use their terminology, his theory cannot easily be accommodated to any of the known semiotic schools of thought.<sup>2</sup> Thus it long remained unknown to those semioticians who trace their origins to linguistics. Sebeok (1979: 187–215) was the first to recognize Uexküll's contribution to general semiotics.

The differences in terminology, however, are not to be regarded simply as a source of difficulty; they may also prove helpful in shedding light on those points where the various semiotic theories diverge.

## 2. What is Umwelt research?

The negative conclusion that Umwelt-research is neither psychology, nor physiology (not even behavioral physiology), nor biology (if confined to molecular biology) must, however, be further supplemented: In many dictionaries of philosophy the Umwelt theory is described as neo-vitalism, and thereby labeled as some kind of a romantic philosophy of nature. This leads to further misunderstandings, because we are concerned with research here, empirical research which, though differing from the so-called exact sciences, does have its own presuppositions, methodology, and objectives.<sup>3</sup> I shall briefly attempt to outline these three points:

1. The *presupposition* on which Uexküll's theory is based reverses the classification of reality held in the traditional philosophy of science: Reality, to which all is subjected and from which everything is deduced, is not to be found 'outside', in infinite space, which has neither beginning nor end, and which is filled with a nebulous cloud of elementary particles; nor is it to be found 'inside' within ourselves and the indistinct, distorted images of this external world created by our mind. Reality manifests itself in those worlds — described by Uexküll as Umwelten (subjective-self-

worlds) with which sense perception surrounds all living beings like a bubble — clearly delineated but invisible to outside observers. These ‘subjective-self-world bubbles’ like Leibniz’s monads, are the elements of reality which form themselves into a synthesis of all subjects and their subjective self-worlds at the same time undergoing constant changes in harmony with one another. This ultimate reality — Uexküll uses the term *Natur* — which lies beyond and behind the nature conceived of by physicists, chemists, and microbiologists, reveals itself through signs. These signs are therefore the only true reality: and the rules and laws under which the signs and sign processes communicate themselves to our mind (*Gemüt*) are the only true laws of nature.

‘As the activity of the mind is the only aspect of nature immediately known to us, its laws are the only ones which may rightly be called laws of nature’. (Jakob von Uexküll, 1973: 40)<sup>4</sup>

Since Uexküll believed that this activity of the mind consists in the reception and decoding of signs, the mind — in the final analysis — is an organ created by nature to perceive nature. Nature may be compared to a composer who listens to his own works played on an instrument of his own construction. This results in a strangely reciprocal relationship between nature, which has created man, and man, who not only in his art and science, but also in his experiential universe, has created nature.

2. *The approach of Umwelt-research*, which aims to reconstruct creative nature’s ‘process of creating’, can be described as ‘participatory observation’, if the terms *participation* (Teilnahme) and *observation* (Beobachtung) are defined more clearly: Observation means first of all ascertaining which of those signs registered by the observer in his own experiential world are also received by the living being under observation. This requires a careful analysis of the sensory organs (receptors) of the organism in question. After this is accomplished, it is possible to observe how the organism proceeds to decode the signs it has received. Participation, therefore, signifies the reconstruction of the *Umwelt* (‘surrounding-world’) of another organism, or — after having ascertained the signs which the organism can receive as well as the codes it uses to interpret them — the sharing of the decoding processes which occur during its behavioral activities. Participation is not, therefore, ‘sympathetic understanding’ (*Einfühlen*), and depth psychology might well profit from this semiotic analysis in its use of the term *empathy*. Uexküll repeatedly emphasized that, where empathy is concerned, the approach of psychology runs counter to the methods of biology (1973: 167).

3. *The objective of Umwelt-research* is to develop a theory of nature’s composition, or to reconstruct the score to the ‘symphony of meanings’ that nature composes out of the innumerable surrounding-worlds

(*Umwelten*) and plays, as it were, on a gigantic keyboard, of which our life and our surrounding-world is but one key (1970b, 176).

### 3. Umwelt research and linguistics

The formula of the reciprocal relationship between man, who must, in his self-world, create nature, and nature, which has brought forth the human species, requires us to consider the relationship between sign processes in nature and in language. Uexküll was primarily interested in one particular aspect of the relationship between Umwelt-research and linguistics, namely the question of the extent to which words, sentences, or numbers<sup>5</sup> in human language may have meaning as signs in animal surrounding-worlds.<sup>6</sup> The works of Peirce, Saussure, Levi-Strauss *et al.*, with which Uexküll was not familiar, call, however, for a more fundamental consideration, since the puzzling formula of reciprocities which expresses the relation between nature and man, bears a surprising analogy to the formula developed in linguistic research to explain the relationship between language and man, and which states that while man has created language, language has created man.

Thus, we are faced with the basic problem of how to interpret this analogy between language and nature, between human and biological sign systems or between linguistic laws and the laws of nature. Are these similarities only coincidental and of a purely superficial kind? Is the analogy merely the result of a romantic, anthropomorphic interpretation of nature? Or are we confronted here with a case of homomorphy, i.e. a fundamental principle which recurs on different levels of complexity, in different ways, yet always in basically the same form — a principle which perhaps involves a hidden genetic correlation?

Accepting this last alternative, Saussure's distinction between *langue* and *parole* (or the more general distinction between code and message) may be viewed as an illustration of Uexküll's own distinction between an active plan and a concrete living phenomenon. When viewed together, *langue*, or code, is the synchronic system underlying the *parole*, or message, in whose spoken words and sentences it is concretely manifested for discursive observation. *Langue* has no other existence than in the step-by-step sequence of speech, but it determines each of these steps. In order to learn about the laws that govern the system our speech is based on, it is necessary to observe the *parole*, the actual spoken language of the people. This is analogous to Uexküll's 'plan'. 'Our mind (*Gemüt*) possesses an inner plan that is revealed only when it is in action. Therefore, the mind must be observed when it is applying itself to the reception and

processing of impressions' (1973: 10) And: '*Gestalt* (form) is never anything else than the product of a plan within indifferent matter — matter which could have taken shape in some other form'. (1973: 183).

Both the concept of speech, or code, and the concept of the plan of nature look like a final resolution of the age-old question of which came first, the chicken or the egg: as concrete phenomena following one after the other, the chicken and the egg are only the manifestation of an underlying plan or system which determines each phase of development.

However, this interpretation of the analogy between the developmental laws that govern the human and the natural sciences is immediately subject to serious objection. The laws of speech are acquired<sup>7</sup> and practiced by living subjects who are adequately equipped with a capacity which is both biological and intellectual — consisting of brain *and* memory, the larynx *and* the ability to vocalize — and who have at their disposal the historical past of the culture in which their language has developed. All these qualities are lacking in the developmental laws upon which metabolism and cell differentiation in the development of living beings, as well as their reactions to stimuli, are assumed to be based. Is it therefore advisable to risk, with the kind of interpretation that models the laws of nature up on the laws of language, an anthropomorphic distortion of the laws of natural sciences, which regulate the behavior of molecules, membranes, and diffusion processes?

#### 4. The problem of the sign-receiver, the law of specific life-energy, and the elementary self

Uexküll rejects this objection as invalid, because it might just as well be raised against the existence of laws in the human/social sciences. No one can, in fact, contend that language invalidates the laws of physics, chemistry, and the molecular biology of air waves, the processes of the inner ear or the auditory nerve, etc. *These natural laws, however, are insufficient for understanding the process of education within the scope of human culture. Here the structural laws of linguistics, which apply to living people and are concerned with significant and meaningful sign processes — not, or at least not only, with supposed physical and biochemical processes as in the field of biology — can be an aid in orientation. Two observations are essential at this point to the understanding of the Umwelt-theory:*

1. The Umwelt-theory postulates that the laws of the natural sciences are not laws of nature, but rules which we derive for our own

objectives from our confrontation with natural phenomena. In saying this, however, there is no attempt to deny their validity; it is only being maintained that a consideration of their validity must also include the contributions of man's perceptual organization, his intention, and his efforts towards abstraction.

2. The Umwelt-theory draws the line not between nature and man, but between animate and inanimate nature. The structural laws which it postulates as nature-plans, and which are analogous to the structural laws of linguistics,<sup>8</sup> are applicable only to living organisms.

The ultimate aim in physiology ... is to reduce biological processes to problems of a physical and chemical nature ... The fundamental activities of tissue, e.g. the contraction of muscles, ... serve as the basis from which physiology, by way of electrical or osmotic processes, etc., seeks to reduce the manifestations of life to the laws of inorganic matter.

Biology has pursued precisely the opposite path. ... Its constituents are ... biological elements [whose interaction it takes as the basis for understanding the life of an organism as a whole]. Therefore, in biology the question of the relationship between animate and inanimate is of no consequence'. (1902: 229)

The line drawn between organic and inorganic nature is not determined on the basis of random distinctive features, such as chemical makeup, size, complexity, or the form of the structure in question, but on the basis of a characteristic quality which can first be observed among living things and which is inherent even in the simplest forms of life, the protozoans. This inherent characteristic is the ability of an organism to react to stimuli, not just in a casual-mechanical way, but with its own specific reaction. From this point of view, all living organisms are considered autonomous, while the inorganic, including the tools and machines we use, remain heteronomous. This characteristic, which clearly and definitely marks the difference between the organic and inorganic, was, as Uexküll has emphasized, first described by Johannes Peter Mueller (1801–1858), a contemporary of Goethe:

Sense impression is not the transmission to consciousness, of a quality or condition of external objects, but rather the transmission of a quality or condition in a sensory nerve, caused by external factors. These qualities, differing in the diverse sensory nerves, are called sensory energies. (1840: 254)

In reference to the above statement Uexküll writes: 'One hundred years ago Johannes Mueller evolved the theory — which has survived only as a mere torso in contemporary physiology that the behavior of every

organic substance is fundamentally different from that of inorganic matter extended in space. A particular inorganic object, whether it consists only of a number of unrelated parts or whether it is a well-made machine based on a thoroughly coordinated plan, reacts toward the external world in a manner distinctly different from organisms and organs which are made up of living cells, because the living cell is autonomous and not heteronomous.

If a machine, for example an automobile, is subjected to external influences of a chemical or physical nature, it only reacts as a coordinated object and can only be set in motion if a gear or pedal is engaged. Under all other circumstances it reacts as an accumulation of metal; its parts move only when pushed, become warm only when heated, and rust when acids are poured onto them.

Mueller pointed out that a muscle reacts in a substantially different fashion. Never does it respond to any external impulse, be it of a mechanical, electrical or chemical nature, like a mass of separate parts, but always as a whole — as a muscle — with a contraction. Mueller called this “specific energy”. At that time the word *energy* denoted vital energy, i.e. an immaterial factor that has nothing in common with physical energy. Furthermore, specific energy is not subject to the law of the conservation of energy which was postulated at a much later date. It could also be described as “holistic energy” — an energy that is non-transferable’. (1931: 208f.)

This means that all living organisms, including cells, behave as subjects, responding only to signs and — for as long as they live — not to causal impulses.<sup>9</sup> Since all living organisms are of cellular composition, both physical development and the confrontation with the environment in its later life can only be understood as responses to signs. All living organisms, as one can also put it, code physical and chemical stimuli as signs.

In emphasizing the autonomy of each and every living organism, another conclusion may be drawn: A sign is never found alone, but always as part of a circular process in which a receptor receives stimuli, codes them as signs, and responds to them as such. The most elementary sign process, the ‘semiotic atom’,<sup>10</sup> so to speak, is therefore that code which governs the life of the cell. The cell furnishes every influence it responds to with a specific meaning, or translates it into its own specific code and then reacts with a specific response. This is the first instance in nature where a quality which we describe by the term ‘self’ appears, namely the ability of an organism to differentiate between self and non-self and to bring them into relation.

The most primitive sign relationship — self and non-self — (in which each is indicative of the other) is also the most universal. In the course

of the evolution of life this sign-relationship differentiates between the non-self as prey, food, enemy, etc., corresponding to the differentiation of the self as hunter, the hungry self, the threatened self, etc. The basis of all these relationships is the self and the non-self (see 9.2). Johannes Mueller's 'specific energy' is what defines (in semiotic terminology) the 'elementary self'.

As soon as we realize that Umwelt-research is the exploration of sign processes that govern the behavior of living subjects, beginning at the cellular level, we can see that there does exist a real analogy between the structural laws of linguistics and biology, which, in the final analysis, abolishes the distinction between the human and the natural sciences. If science is understood as the attempt to identify the factors which determine the behavior of phenomena in relation to each other and toward man, then Dilthey's famous distinction is no longer valid for a theory of signs. 'Explaining' (*Erklären*), which according to Dilthey is restricted to the natural sciences, becomes identical with 'understanding' (*Verstehen*), which he reserved for the human sciences.

Thus, we can compare terms such as system, structure, unit, code, etc., which have been taken from linguistics, to the terminology of the Umwelt-theory, because the linguistic terms seem to illustrate the concepts of the Umwelt-theory in a more precise manner than do the illustrations drawn from music, which Uexküll favored.<sup>11</sup>

## 5. The private nature of signs

There is one more characteristic quality of sign processes that must be considered, which is also of fundamental importance to an understanding not only of the Umwelt-theory, but also of every other theory of signs.

It may be said that every sign is, in the strictest sense of the word, 'private', or, in other words, there is no such thing as an objective sign. There are only sign systems with the same structure and the same code for different receivers. This conclusion is the counterpart to the autonomy of living organisms. What each sign means to the subject as a receiver is registered only by the subject itself or, as Uexküll has stated: 'A living cell possesses its own ego-quality (*Ichton*)'. (1931: 209)

This conclusion has far-reaching consequences that can be reduced to a common denominator: the inevitability of self-experience if one understands by this the conclusion — which in various ways and degrees has agitated all philosophers — that in everything experienced, we are simultaneously experiencing ourselves, Uexküll has confronted this fundamental problem with reference to Kant. He writes:



Kant categorically rejected the idea of the naive observer with his thirst for knowledge of the physical forms around him, studying and comparing their effects upon one another. Examine first what you yourself as a subject bring into nature before you start to examine the nature of things that surround you. Examine your own perception before you make a critical interpretation of what you have examined!

Kant now taught him that time and space are not objects that can be removed from the mass of other objects to be examined and touched by themselves, but that they are forms of our perception. From the very moment we turn our interest to the study of nature, we necessarily include time and space in our observation as a flexible framework, which completely encompasses all the phenomena present in each case, and in which all things — large and small, far and near, past and future — are set.

The qualities of all things, as Kant further states, are not their own, but of our own projected perception. The range of qualities present in all things extends just so far and no further than the range of our sensations'. (1947: 6f)

In other words, what we experience of nature is cloaked under the guise of our self-perception, or:

All reality is a subjective appearance. This must form the major fundamental understanding in biology as well ... With this recognition we are standing on the solid ground which was uniquely prepared by Kant to support the edifice of all the natural sciences. Kant has placed the subject called man in opposition to the objects, and has outlined the basic principles according to which the objects are formed in our mind.

The task of biology is to expand the result of Kant's research along two lines: (1) To consider the role of our body, particularly our perceptual organs and the central nervous system and (2) to study the relationship of other subjects (animals) to their objects. (1973: 9f.)

With these two imperatives Uexküll defines the scope of his theory of signs. The theory proceeds on the assumption that we must first examine the 'primary receiver' of signs, that is, ourselves and our minds, and that *only then can we place other subjects, especially animals, in the role of sign receivers.*

## **6. The composition of man's experiential universe seen as a composition of sign processes**

### *6.1. Preliminary note*

The basic concept that life on the elementary level is sustained by cell subjects which, as autonomous units, transpose every impulse into sub-

jective (private) signs — their ego-qualities — and which react only to these signs, requires investigation on two levels:

1. It requires the development of a new 'anatomy' with which to clarify how higher forms of life with complex tasks are formed from the amalgamation of cell subjects and their elementary sign processes. This 'anatomy' must 'dissect' first the subjective Umwelt of the researcher, ascertaining how it is constructed from the elementary processes (the sign processes) of the cells and organs of his body.
2. It requires a description of how the 'objective outer world' in which we observe ourselves and other living things develops from our subjective (private) universe — our Umwelt. This means, in other words, how the objective outer world is derived as an abstraction from our subjective universe. This problem can only be solved by an epistemological biology or a biological epistemology. This means biology and epistemology are joined together as one field of research.<sup>8</sup>

Only when this twofold problem has been solved is it possible to undertake the actual task of Umwelt research: To construct, from the knowledge gained about the structure of our human experiential universe, a model for the reconstruction of the experiential universes of other living things (their Umwelten).

The analysis of the human mind as a sign-receiver and the way it works in the construction of our experiential universe exhibits a structure or 'anatomy' which is most impressive in its analogy to the structure of language: Just as language has signs of different integrational levels (phonemes, words, sentences, etc.), so the analysis of our experiential universe brings to light different levels, on each of which sign processes of varying complexity may be studied. On each of these levels the signs also reveal surprising analogies to the signs in human language.

## 6.2. *The elementary processes of signs*

Two classes of sign processes belong to the elementary level: the 'organizing signs' and the 'content signs'. Both are conveyed from specific sensory cells as receptors.

The organizing signs, which will be considered first, may be described as the ego-qualities of cells, found either as tactile cells in the skin on the surface of our body or in the eye as specific perceptive cells in the retina. They respond to every stimulus with *local signs*, which we perceive as

'positions' in our subjective universe. An organizing framework is thereby formed through a mosaic of positions.

When two tactile cells in the skin or perceptive cells in the retina are stimulated successively in such a way that the 'ego-quality' of the first cell is diminishing while that of the second is increasing, then a new sign is created: The *directional sign* which connects two positions through a movement. Local signs and directional signs can only produce a two-dimensional surface of positions. Only through the active intervention of muscular activity which mobilizes the surface of the skin (primarily of the hands and arms) with its tactile cells, or which effects a change in the curvature of the optical lense, is a shift toward depth, and thereby into the third dimension, brought about.

It is still necessary, therefore, to be informed about the voluntary impulses which account for muscular activity. The signs responsible for this feedback are the *effector signs*, which are produced in the intention of muscular activity — that is, before the movement has even begun. What we are dealing with here is the feedback (to the periphery of the receptor) of the nerve-action current, which Erich von Holst and Horst Mittelstaedt (1950), on the basis of their neurophysiological test results, described as the re-fference principle. The effector signs are responsible not only for the third dimension of space, but also for the ability to distinguish between our own movements and the movements of other things. The significance of this type of feedback in the construction of a central control system, which forms the basis for such phenomena as the will, consciousness, and ego-formation, is noted here only in passing. Their significance for general semiotics, however, cannot be overestimated.

Within the scope of the Umwelt-theory a different aspect of the effector signs is emphasized, namely the significance of the apriority of space. These signs, resulting from the feedback of the intention of will, function independently of external influence (1973: 38). This fact explains the ability of the mind to develop a concept of space which lends stability and order to our experiential universe without the aid of external experience. Space is hereby revealed as a 'major component in our sensory organization and, as such, is a true law of nature, having both subjective and objective validity' (1973: 39).

The same is true of time, whose elementary sign manifests itself as a 'moment'. However, in contrast to the elementary signs that form space, no success has as yet been achieved in the search for specific cell subjects that would act as mediators. Moments are therefore conceived of as signs of the synthetic, serially phased functioning of the mind, and apperception is regarded as a life process (1973: 70).

Local signs, directional signs, and effector signs, together with time signs are the constituents of time and space in our experiential universe. As they impart to this universe the framework into which all other signs are set in the form of content, they are called *organizing signs*. These signs are the 'organizers of the world' (1973: 111).

The *signs of content*, color, sound, smell, etc., which we will now consider, may also be classified as specific ego-qualities of certain cell-subjects. In the higher forms of life these take shape as the receptors in the sensory organs (eyes, ears, nose, etc.).

Within the framework of the complex organization of the human body, the sensory cells are linked, by nerves, to specific areas of the brain. Thus their ego-qualities depend on the functioning of a chain of coding and decoding processes in successively activated cell subjects. However, the cell subjects in the periphery of the sensory organs not only stand at the beginning of these processes, they themselves also initiate them through their own subjective reactions to stimuli. It is therefore, correct to assume that they are the elementary components of our sensory organization and that their ego-qualities are the elementary sign processes.

### 6.3. *The codes of the elementary sign processes*

We will now turn our attention to the analogies between the laws inherent in linguistics and those on the level of elementary signs. On this level, three aspects can already be clearly noticed, which are surprisingly similar to the aspects that Charles Morris identified in signs. In my opinion it is of particular interest to general semiotics that two researchers who, without knowledge of each other, developed a concept of the sign from totally different starting points, with altogether different objectives, and working in completely different fields, have discovered similar inherent laws.

Charles Morris (1938) distinguished between the syntactic, the semantic, and the pragmatic aspects of signs. These three aspects can also be found in Uexküll's elementary sign processes:

1. *The syntactic aspect*, which refers to the relationship of signs to one another, is revealed in the fact that all elementary signs exhibit a highly remarkable system of affinity (1973: 13). There is, for example, a system of affinity in the scale of color quality that assures that each color has a definite relationship to other colors. This system of affinity may be graphically illustrated as a hexagon or a chromatic circle. The system of affinity for sound may be illustrated by tonal scales, the one for odor by

aroma scales. This same principle applies to heat, degrees of hardness, taste, etc.

These systems of affinity — and this is what makes them so fascinating — are always perceived unconsciously whenever a single sign appears. When we perceive the color red we always 'see' that it is not green, yellow, or blue, but in an organizational relationship to all colors not at the moment visible. We also see the intensity of a red color on the invisible scale which grades from pale pink to the most intense red. The same applies to sound: In each individual tone heard, the complete scale of all other tones and the gradations of their intensity resonate as it were silently. This same principle applies to the perception of heat, odor, touch, and taste.

When we perceive a single sign, therefore, we are unconsciously perceiving the complete organizational system of all signs that belong to that particular system. This fact implies (in linguistic terminology) that the discursive sequence of individual signs (seen, in speaking, as the chronological order of words) is always embedded in the syntagmatic background of the system and its structure, or shows that the form (*Gestalt*) of the system, only synoptically comprehensible, is yet what determines, though unconsciously, the sequential process of the signs. Just as the game of chess (to use Saussure's example), which is only comprehensible as a system of abstract rules and relationships synoptically, governs every move, in the discursive sequence of an actual game, so, analogously, the abstract systems of the individual sensory spheres, with their organizational relationships, have the power to create in the discursive sequence of our concrete perception colors, odors, as well as the signs of touch and taste. To this creative power, which Saussure describes in language as *langue*, Uexküll applies the term *plan* in the field of biology. Each individual sign is only part of the hidden wholeness or systematic arrangement of a sign system comparable to the tip of an iceberg which projects above the surface of the sea (Hawkes, 1977).<sup>12</sup>

2. The *semantic aspect* of these laws, or this systematic arrangement, which reveal themselves in the organizational relationships, can be observed in the ability of the system to define itself and its elements, in an independent and, as it were, completely arbitrary manner. Each color — with respect to its quality, that is, its semantic meaning (of red, yellow, green or blue) — is defined only on the basis of its relationship to the integrated system of the color chart. The same applies to all other sensory signs: tones, where quality of meaning is determined by the tonal scale; heat, where the quality of meaning is determined by the temperature scale; etc.

Perceived unconsciously and simultaneously with each individual sign,

this systematic arrangement of all signs belonging to the same category (their structure of meaning) has an interesting consequence for the organizing sign: Through each local sign corresponding to a touch of the skin or the stimulation of a point on the retina, we 'know' where to localize it in the space that surrounds us and of which our body is a part; we know, that is, whether it is above or beneath, to the right or to the left, ahead or behind. This means nothing less than the fact that the active plan or code, *space*, is constantly present in our mind as the semantic system of local signs. The structure of this space is not deduced from any concrete experience: it is *a priori* (1973: 38f.). The same potential organization which we cannot escape — however hard we try — dwells in our mind as *time*. Time is the semantic system of the moment signs which are always arranged on a scale where a 'present' is located in between a past and a future.

Semantic systems for the content signs, and semantic systems for the organizing signs with their law-governed structures, are abstract patterns. However, they produce the concrete signs which become meaningful only as elements of their semantic system, that is, only through the semantic system are the syntactic organizational relationships to other signs set up. Signs reach beyond themselves and refer to something which they themselves do not possess. On the level of the elementary sign processes this is in fact the system which makes organizational relationships between signs possible.

The self-contained, self-sufficient, self-defining character of the semantic systems of biological elementary signs, their as it were 'inward' only, but not 'outward' embedment, is the prerequisite for their capacity to be combined with the signs of other systems on a more complex level.

3. No less remarkable is the *pragmatic aspect* of signs in the Umwelt-theory. This aspect implies two different perspectives: The first refers to the distinction Uexküll makes between *perceptual sign* (Merkzeichen) and '*perceptual cue*' (Merkmal). Each perceptual cue (or 'characteristic feature') is a perceptual sign that is 'transposed to the outside'. In other words, whereas the perceptual sign is received as an ego-quality of a sensory cell within the subject, the perceptual cue lies outside in the space of the external world (see also object).

This is an indication that all perceptual signs, no matter what quality, always appear in the shape of an order or impulse ... When I say the sky is blue, then I do so because the perceptual signs, which I have transposed to the outside, give the order to the most distant level: 'Be blue!' ... While constructing our world the sensations of the mind become the properties of things, or, as one can also put it, the subjective qualities form the objective world. Replacing sensation or

subjective quality with perceptual sign, one can say that the perceptual signs of our attention turn into perceptual cues of the world. (1973: 102)

For the local signs, which we receive on the surface of our body through our skin or through the retina, this aspect of impulse or command means 'Be outside' at this particular point of space, which as a command has in this way been transposed to the outside! The expression 'transposed to the outside', which we regularly encounter in Uexküll's works, only becomes plausible in the light of this pragmatic aspect of local signs. Or in other words, the quality, *outside*, can only develop when the local sign (which appears as ego-quality of the sensory cells in the skin or retina) is transposed to the position which, as perceptual cue, fulfills the command that it be localized in space.

The second perspective answers the question which from an epistemological standpoint is of central importance, namely how we derive the image of an objective world, with its physical features, from our subjective universe and, at the same time, what this world, on which our scientific observation is based, means to us and our experiential universe. Here we have to take into consideration the general system and its structure of relationships in which all organizing signs are related to one another and to our effector signs. Thus we can see that our experiential space, which is composed of a tactile space (of the local signs of the skin), a visual space (the mosaic of loci on the retina), and an operational space, reflects the basic pattern for all programs which connect our sensory perception with the possibilities of active motor intervention. From a biological perspective, force, matter, and causality are only the general formulas for the possible dispositions of the varied, innumerable, visual and tactile loci existing within the space of our experimental universe to the possible muscular movements under the control of effector and directional signs.

Each colored area of our visual field, whatever kind it may be, is an obstacle, which can be near or far. They all awaken the same sensation, namely that of an obstacle, similar to a resistance which a hand encounters in touching an object. This is what gives them their material character, which generally speaking signifies nothing other than a real obstacle. Thus we describe as material all things that prove their reality by acting as obstacles. (1973: 61)

Force (*Kraft*) is originally nothing but a sensation linked with the movement of our muscles. This muscular sensation is spontaneously inferred to be the cause of the movement of our limbs, and then the cause of movements in general ... *By reduction of the material processes in space to local and directional signs, the subjective nature of these phenomena as well has been proven beyond doubt, and thus the position of the so-called natural sciences within the field of biology has been clearly marked.* (1973: 64–66; emphasis by T.v.U.)

This means nothing else but the fact that, through consistent abstraction from all content signs and perceptual content cues the natural sciences construct a representation of the world which is composed of organizing signs only. This is the solution to the second problem described above. The significance of this abstraction of an 'objective' image of the world as the parameter for a cooperation between various human subjects and thus for the development of a human culture is evident (see also neutral object [*Gegenstand*]).

#### 6.4. *The complex levels or the combinatorics of sign processes*

The linkage of sign processes to all cell subjects (as their ego-qualities) has the advantage of making plain the parallels between complex signs and the complex structure of the sensory organs in higher forms of life. Even the combination of organizing signs with content signs, and *a fortiori* the reciprocal relation of local signs to effector signs in our subjective universe (a relation upon which, as we have seen, our concept of an objective external world is based) depend on complex nervous connections between receptive cell subjects and control mechanisms in a central nervous system. This raises the question as to how the complex signs have developed, which as objects and processes constitute our experiential universe and which in all surrounding-worlds of higher living forms have a directive function no less vital than that of navigational aids for the sailor. What does the bond look like, that links the elementary organizing and content signs with the sharply outlined objects and processes, 'which we see everywhere around us and whose unity we do not doubt' (1973: 116)?

If we observe our mind when it is actively constructing and recognizing the objects and processes in our environment, we will find that we do not just resort to static memory images. Instead, the process of image formation is itself repeated, and the sequence of impulses for our muscular movements (e.g. when feeling the outline of an object with our hands or looking at some writing with our eyes) is thereby compared with programs of impulse sequences which are stored in our memory. Following Kant, Uexküll calls these programs *schemata*.

'Our whole memory — like the fly of a theater with its pieces of scenery — is filled with schemata which from time to time appear on the stage of consciousness ...' (1973: 121).

The private character of signs, which we have already emphasized with reference to the elementary sign processes (the perception of a color, a sound, a taste is just as strictly a subjective, private experience as the



perception of a pain), applies just as strictly to the complex signs which we construct by means of programs or schemata. The table, the house, the tree which I perceive are also part of my experiential universe and are not identical with the table, the house, or the tree in the subjective universe of another person. 'Unfortunately, we have no access to anyone else's stage of consciousness, as nothing could be more enlightening than to see the world through someone else's schemata. However, one thing should not be forgotten: When we see other people walking around us, they are walking on our stage while we do so on theirs. These stages are never identical, and in most cases are even entirely different. And we cannot expect to play the same part on someone else's stage as on our own' (1973: 121f.).

At this point let me make a few explanatory remarks to suggest some connecting lines that lead from Jakob von Uexküll's Umwelt-theory to a human biology. A schema is a strictly private program for the formation of complex signs (neutral objects, etc.) in our subjective universe. Language produces intersubjectively valid signs, namely words (signs for the signs of the schemata). Thus language not only makes it possible to intersubjectively exchange information on the object-forming processes which take place in our experiential universes; it also makes it possible for all who hear the word to activate the same processes of formation. However, Uexküll's qualifying statement is still true: The schemata which we have formed during our life are intersubjectively identical only in the most general outlines.

On the complex level as well, signs can be analyzed under syntactic, semantic, and pragmatic aspects. In so doing, it becomes clear that the abstract systems which we 'simultaneously perceive' as synchronic structures in the background of each complex sign are completely different from those on the level of elementary sign processes. On the complex level it is these systems which are the units of biological operations. The Umwelt-theory describes them as *circles* (Kreise) and distinguishes a food circle, an enemy circle, a circle of sexual partners, and a circle of the medium.

In each of these circles a *syntactic organization* ensures that the signs which appear in chronological order correspond to the catch words of the respective operation. Thus each newly occurring sign — according to the inherent logic of the operation — takes up where the preceding process left off and prepares for the following one. The operation in the prey circle, for example, starts with the optical sign of the prey spotted; this is followed by tactile signs when seizing the prey, which are followed in turn by signs of taste when the prey is devoured. Thus the prey 'has' optical, tactile, and taste qualities.

The *semantic organization* now ensures that each sign emphasizes a common purpose which distinguishes one circle (e.g. as food circle) from other circles (e.g. the enemy circle). Thus the same neutral object — as a meaning-carrier — can mean ‘feed’ within the food circle, ‘danger’ within the enemy circle, and ‘obstacle’ within the medium circle. In this way it changes its meaning from circle to circle, that is, it transforms each time into a different object within the surrounding-world of the living being under observation.

In the *pragmatic organization* signs become operational instructions. They tell the subject (like navigational aids to the sailor) what to do.

## **7. The subjective universe of the observer as the key to the self-world of the animal under observation**

### *7.1. Neutral object and meaning-carrier*

As mentioned above, Jakob von Uexküll devoted himself to two tasks:

1. First, to analyze the subjective universe of the human observer. Apart from an ‘anatomy’ of this subjective universe this also includes the solution to the question of how the representation of an objective external world, in which man observes himself and other subjects, is derived from his subjective universe.
2. Second, to place other subjects, *viz.*, animals, in the role of sign receiver.

I have shown how Uexküll resolved the first problem. Before I try to describe his resolution of the second, I would like to outline how his resolution of the first problem affects his approach to the second one.

The analysis of the manner in which the human mind functions as ‘primary receiver’ shows how our surrounding-world (Umwelt) is composed of signs received by the cells which together comprise our receivers, the sensory organs. From this directly perceived subjective universe our intellect derives an objective external world which we assume to be the common stage upon which we and other subjects perform. In reality, however, it is a representation of the world which we, disregarding all content signs, have constructed from the organizing signs to which our subjective Umwelt owes its spatial and temporal arrangements.

The importance of this conclusion lies in the fact that the observer cannot perceive other subjects in their surrounding-worlds, but only

within his own. They appear to his mind according to the organization of space and time that governs the human surrounding-world. This would not change even if we were to describe our observations in the terms that physics has developed to refer to the objects and processes of an objective, external world. When the observer wants to shift viewpoints and place other subjects (animals) in the role of the human sign receiver, he has to realize that there are objects in his world which never appear in the surrounding-worlds of animals. Chief among those things which do not occur in animal self-worlds are neutral objects because animals never approach their environment as neutral observers.

'Since no animal ever takes the role of an observer, one can maintain that an animal never builds up a relation to a "neutral object"' (1970: 108).

No neutral objects exist in animal behavior, only objects on which they are dependent as a result of biological needs (e.g. hunger) and which disappear from their surrounding-world as soon as the need has passed. Neutral objects have constancy, and we can maintain a certain distance from them. Objects of animal surrounding-worlds have neither constancy nor distance for their animal subjects. A dog that chases a hare is compelled to do so as long as the hare remains in its visual or olfactory field. As soon as it has disappeared, it has stopped being an object in the surrounding-world of the dog.

The human observer, therefore, who wants to place an animal in the role of sign receiver, must transpose the neutral objects which he sees spread out around the animal into objects of the animal surrounding-world. To this end he must realize that as soon as a subject builds up a relationship with them these neutral objects become meaning-carriers whose meaning bears the stamp of the subject.

'Each component of an animate or inanimate neutral object, as soon as this component appears in the role of a meaning-carrier on the life-stage of an animal subject, is brought into connection with what may be called a complement in the body of the subject, which serves as a meaning-utilizer'. (1970: 111)

The transformation of a neutral object of the human subjective universe into a meaning-carrier that takes on the meaning determined by the animal under observation is the decisive step. Only those who have learnt to share this step in a systematic manner are entitled to call themselves Umwelt-researchers.

This takes us to the core of the method developed by Uexküll: The transformation of a neutral object which the scientist can measure, weigh, separate, and alter according to the laws of physics into a meaning-carrier

whose meaning is determined by the animal subject and is transformed by it into a sign in its sign system: This sign refers to a meaning-utilizer in the organism of the animal, just as within our subjective universe the sign *light* (as a meaning-carrier) refers to our eyes (as meaning-utilizers) or the sign *tone* (as a meaning-carrier) refers to our ears (as meaning-utilizers).

Thus it can be reduced to the formula: neutral object → meaning-carrier + meaning (= reference to the meaning-utilizer) = sign. This formula, as Uexküll stresses, is more important for biology than the formula of causality: cause → effect = cause → new effect. Whereas the formula mentioned first governs the subjective universes of all living organisms, the second one applies only to the neutral objects of the human subjective universe and the 'objective' representation of the world which is derived from it.

However, looked at from the latter perspective, the formula of causality is also of significance for the biologist: With the neutral object which he registers in the environment of the animal, the observer as it were holds the 'handle' of a non-human sign in his hand, which projects from the surrounding-world (to him invisible) of the animal under observation into the surrounding-world of the observer. By way of dexterous manipulation of this handle he can alter the non-human sign 'attached' to it, and in this manner experimentally investigate the meaning the sign has in the animal's surrounding-world. In an early work of 1905, Uexküll is already comparing the objects of the natural scientist that have significance in the surrounding-worlds of animals to keys, and the animals to music boxes that can be wound up and set in motion by means of these keys.

## 7.2. *The meaning-carrier as connecting link between heterogeneous sign systems*

The term *meaning-carrier* requires two further explanatory remarks:

1. The meaning-carrier falls, as a sort of chimera or Janus-faced structure, on the border that divides two different sign systems. In each of them it 'carries' a different meaning. Thus, metaphorically speaking, it links two different meanings and becomes a connecting link between heterogeneous sign systems. In each of them it represents a sign that is unknown in the other. Thus in our example, the meaning carrier in the surrounding-world of the human observer had the meaning of a physical object, which relates it, as a sign, to other physical objects and to the

physicist as meaning-utilizer. This meaning does not exist in the surrounding-world of the animal under observation. Here the meaning-carrier takes on a completely different meaning, for example that of an obstacle which (as a sign) refers to the motor organs of the animal (as the meaning-utilizer) or that of a prey that (as a sign) is meaningful to the raptorial organs of the hunting animal. Thus the meaning-carrier is transformed into a sign pertaining to a biological sign system whose meanings are not part of the surrounding-world of the human observer but have to be deduced from the animal behavior under observation.

2. Meaning-carriers do not necessarily have to 'project' as physical objects from the animal self-world (invisible to the observer) into that of the human observer. Thus, for example, sounds an animal hears or produces can take on the meaning of an alluring melody or a cry of fear in the surrounding-world of a human observer, although they may have a completely different meaning in the animal's subjective-world. As sounds, they have in both subjective-worlds the meaning of acoustic signs which belong to an acoustic sign system. The code of these sign systems, however, are very different. Sounds are not physical processes, and yet they fulfill the function of meaning-carriers that link meanings from different sign systems (T.v. Uexküll, 1979).

Sounds can of course also be related to the sign system of the physicists. Here they can be measured as vibrations of the air and be related to vibrations of different frequencies. If, however, vibrations of air find their way to a subject with ears, they are transformed into meaning-carriers which link sign systems separated by semantic borders: They link the meaning of physical signs (vibrations of air) with the meaning of biological signs (tones).

As connecting links of heterogeneous sign systems, meaning-carriers can string together chains of different signs or give rise to intricately designed, net-like or hierarchically arranged structures which exceed semantic boundaries of many sign systems. Their formation, however, requires a link of meaning or transformation at each boundary.

It is always astonishing to see how effortlessly such complex structures as these chains are formed in nature, taking into consideration the fact that all signs we receive must previously be translated into the signs which our nervous system transports in the form of action currents. The nerve action currents are transformed into sounds or colors and these into words or images, which in turn are translated into even more complex signs.

These observations show the outstanding significance of the formula Uexküll has developed in order to gain access, as a biologist, to the animal worlds from which we are excluded.

7.3. *The meaning rule as the rule of correspondence between point and counterpoint, or as the rule of systems formation*

The formula of sign = meaning-carrier + meaning (and meaning = reference to the meaning-utilizer) not only applies intra-individually, within the organism, to sign systems of cells, tissues, and organs, as well as to the relationship between the sign system of the organism and its surrounding-world; it also applies inter-individually, to sign systems of such different organisms as plants and animals. Thus, as it is expressed in the theory of meaning (1970:136) 'the meaning rule' serves as '[... the] link between two elementary rules'.<sup>13</sup>

In the terminology of Bertalanffy's systems theory (1968) we would say that the formula for signs, which Uexküll refers to as *meaning rule*, describes the structure of systems and that it is therefore valid within a system, but also valid between systems, once these have been joined together in a suprasystem. Thus, with this formula it is possible to research the composition of sign systems which govern the society of plants and animals in a biotope or in a biocenosis.

In the theory of meaning (1970:111f.) this is illustrated by an example that shows what different meanings the stem of a flower (as meaning-carrier) takes on in the subjective worlds of a girl, an ant, a cicada, and a cow. In the girl's subjective world the flower stem has the meaning of a handle for an ornament that the girl pins on her bodice. In this context the meaning refers to the girl's hand as the meaning-utilizer. In the self-world of the ant, the meaning-carrier *flower stem*, with its rough surface, refers to the legs of the ant which (as the meaning-utilizers) use the stem as their footpath, etc.

In order to illustrate the formula of sign = sign carrier + meaning (the meaning rule) as clearly as possible, Uexküll refers back to a term in music theory, which describes the way two tones complement each other as *point* and *counterpoint*. Plessner (1976) speaks of a *law of correlations*: 'According to the principle which Uexküll once formulated in this manner, one must conclude that where there is a foot, there is also a path, where there is a mouth, there is also food, where there is a weapon, there is also an enemy ...'

The comprehensive meaning structure of the contrapuntal correlation describes the structure of signs (*aliquid stat pro aliquo*<sup>9</sup>). This correlation is convertible, so that the organism of a living being and its surrounding-world are complementary to one another, which means that the surrounding-world as a sign refers to the organism of the living being just as the organism as a sign refers to its surrounding-world.<sup>14</sup>

Thus the formula of the contrapuntal correlation of meaning-carrier

and meaning in a sign becomes significant for Uexküll as the instrument of a biology which sees the development of a theory of the composition of nature as its task (1970:140). In this theory of composition the properties of our surrounding-world and our sensory organs are also composed for each other. Thus, for example, one can say that our eyes (as *meaning-utilizers*) are 'complementary' to the light-emitting sun, just as the sun (as meaning-carrier) refers to our sight-giving eyes. To Goethe's saying:

Were our eyes not like the sun,  
Never could they see it

one must therefore add:

Were the sun not like our eye,  
It could not shine in any sky. (1970:158)

## 8. The functional circle as a special case of the contrapuntal correlation

The general validity of the initially proposed linear formula for signs involves a problem in the task Uexküll wants to complete, namely to place other subjects (animals) in the role of the human sign receiver. This difficulty is made clear in his reference to a fundamental difference between plants and animals: Animals possess surrounding-worlds, plants, however, only *dwelling envelopes* (1970:114).

This distinction implies that the meaning-utilizers of plants and animals differ in an essential point: In plants the utilization (of the meaning-carrier) is centrally executed by one and the same organ, whereas in animals this task is shared by two different organs with different functions. In the latter case a perceptor organ (receptor) and an operational organ (effector) must cooperate for the meaning-carrier to be utilized.

Thus, for example, the birch leaf is able by means of its chlorophyll to ensure the utilization of the meaning-carrier *solar energy*, or by means of its form, which is like a flag, it can use the meaning of the meaning-carrier *wind* (1970:119). In animals this centralized process is separated into receptor and effector components. Thus even so apparently simple a reflex as the blink of an eyelid requires, when a foreign body is approaching, the cooperation of receptor and effector functions in order to enable the animal to utilize the meaning for the eye (*foreign*) of the meaning-carrier *foreign body* (1970:115).

For this reason, the simple formula of the contrapuntal relationship of signs does not suffice to transform neutral objects of the surrounding-world of the human observer into objects of the surrounding-world of

an animal under observation. It was necessary therefore to modify this formula in such a way as to enable it to describe the different functions of the perceptor organ and the effector organ as well as their cooperation. With this aim in view Uexküll developed the formula of the *functional circle*, which anticipates by twenty years the mathematical formulation of the feedback principle by Norbert Wiener (1943).

To this end it was necessary to specially redefine two terms for sign theory, which had regularly led to misinterpretations due to their psychological connotations: The terms *perception* (Merken) and *operation* (Wirken). F. Brock (1949:173), a longstanding collaborator of Uexküll's, describes the problem that was to be solved by this definition as follows:

The non-expert is only too willingly inclined to describe 'operational' and 'perceptual' processes as conscious and voluntary operations. Unfortunately, we have no access at all to the inner life of other creatures. ... Even human beings consciously perceive only a small fraction of all biological processes. If, for example, we put a drop of acetic acid of a particular concentration on our tongue, we will perceive the taste of something sour; and if we put a drop with the same concentration on the sphincter of the stomach it will contract, but there is no sensation of taste. Looked at from a biological point of view, the tongue as well as the pylorus 'perceive' something, but only in the first case do we experience the perceptual cue consciously

'Looked at from a biological perspective' refers to a process which has to be described in terminology that is indifferent to the opposition conscious/unconscious. 'Perception' in this terminology denotes the first phase of a process of meaning-utilization which has to be supplemented by a second phase in which an operation confirms what has been 'perceived.' In this respect operation has just as little to do with the psychological phenomenon of a voluntary act as perception with that of conscious awareness.

With this distinction that the sign process undergoes as life proceeds from vegetative to animal forms, the first stages of a genealogy of the development of signs become apparent. Consciousness and volition, or conscious perception and conscious transmission of signs, can be described on this foundation as further differentiations of the vital sign process (T.v. Uexküll, 1980:81f.).

The basic model for those further differentiations is the functional circle (Figure 1). It describes how (in sign processes) the process of meaning-utilization differentiates into perception and operation and how both cooperate as partial functions. It shows how the subject as meaning-utilizer and the object as meaning-carrier are linked in a unified whole, a system (or complex sign).



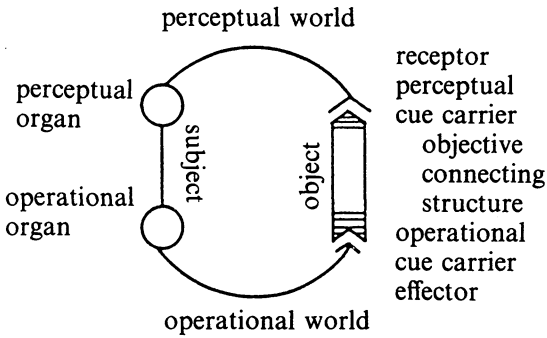


Figure 1 *The functional circle*

'Metaphorically speaking, each animal subject grasps its object with two jaws of a pair of pincers — a perceptual jaw and an operational jaw. With the first jaw it imparts to the object a perceptual cue (*Merkmal*), and with the second an operational cue (*Wirkmal*). Thus particular properties of the object become perceptual cue carriers and others become operational cue carriers. Since all properties of an object are linked together through the structure of the object, the properties represented by the operational cue are forced to exert through the entire object their influence on the properties which carry the perceptual cue and also to modify the perceptual cue itself. This process is best described by the words: *The operational cue extinguishes the perceptual cue*. (1970:11)

In Figure 1, the meaning-utilizer has differentiated into a receptor organ and an effector organ and the meaning carrier into a perceptual cue carrier and an operational cue carrier. Since this model applies to all sign processes taking their course on the stage of animal life, that is, to anthroposemiotic as well as to zoosemiotic ones, it becomes possible by this means to solve the problems of placing animals in the position of the human sign receiver and to transpose neutral objects from the surrounding-world of the human observer into objects of the surrounding-world of the animal under observation. To this end the observer has to analyze the receptors and effectors of the animal. Then he can ascertain which signs the animal can receive and which of them it can transmit. This knowledge puts him in a position to translate the neutral object, which he registers in his human surrounding-world and which appears in the model of the functional circle as an 'objective connecting structure,' into an object of the animal's surrounding-world, by putting the features and operations characteristic of the animal in place of human ones.

## 9. Essentials of Jakob von Uexküll's theory of signs

After this attempt to sketch Uexküll's theory of signs, I want to describe some of its essentials in more detail. This will bring out certain contrasts and clarify similarities and differences between this and other theories of the sign.

### 9.1. *Meaning as a process of meaning-utilization*

In the simple formula of sign = meaning-carrier + meaning and meaning = reference to the meaning-utilizer, 'meaning' has the central function of bracketing heterogeneous elements into a whole (the sign). For Uexküll one of these heterogeneous elements (the meaning-utilizer) is an organ, that is, part of the organism of a living subject. Thus the formula, meaning = link between carrier and utilizer, takes on the nature of a dynamic process. Signs are realized as sign processes.

The formula or model of the functional circle makes it evident that this process does not exhaust itself in the linear coupling of links in a chain, but rather that it has a circular form: meaning-carrier and meaning-utilizer become elements of a 'force field' within which they are driven apart and linked together again.

When a meaning-utilizer in the organism of a living being 'harpoons' with the link-forming meaning some neutral object from its environment as a meaning-carrier, a fight or game between two unlike partners begins, one of which plays the part and the other the corresponding counterpart (point and counterpoint). Thus meaning turns out to be a 'drama', which deals with meaning-utilization. Thus the metaphor of the 'anatomy' of a surrounding-world takes on a deeper meaning; for now we see invisible tentacles coming out of the cells and organs of human and animal bodies, searching for meaning-carriers in the environment — in order to then connect them with the cells or organs. These 'tentacles' extend the anatomy of the organism into its surrounding-world.

In this way, signs suddenly come alive. We can follow them in the interplay between the organism of a living being and the meaning-carriers in its environment. Here we can 'see' how in the dramas between organizing signs and content signs neutral processes of the external world are received as meaning-carriers by the sensitive cells of our sensory organs, and are utilized as sensible stimuli. We can also see how physical vibrations of the air are taken up by our ears and become involved in the interplay between the tympanic membrane and the acoustic apparatus of the inner ear, in which sound originates. We 'see' the same interplay

between photons and the retinal cells of the eye. Again a little drama takes place which produces the sign 'light' from parts and counterparts.

We can then see the plots of the dramas becoming more complex, but here too the part of the meaning-carrier always corresponds to its counterpart meaning-utilizer, and we see how the script of the action (the schema) again varies the subject matter 'meaning-utilization'. The work of the organism (as meaning-utilizer), Uexküll wrote elsewhere (1935), always corresponds to the complementary function of the object (as meaning-carrier). Thus, for example, a chair is only defined by its complementary function to the operation of our body, namely sitting: It has a 'sitting quality'.

The formula of the functional circle thus describes the basic structure of the dramas which take place between the human and animal organisms and the objects of their surrounding-worlds. These dramas consist principally of two acts: In the first act a neutral object from the environment is 'harpooned' as a meaning-carrier by a perceiving organ or a perceiving cell, in the second act it is modified by the effector organ (as meaning-utilizer) in such a way that it disappears again from the surrounding-world. 'The operational cue extinguishes the perceptual cue'. Thus the condition has been created for the emergence of the next sign in the chronological sequence of the discussion which the living being holds with its objects.

This basic structure of the sign process even applies to the simple formula that only at first glance describes a linear process. When the sign relationship is established between a vegetable organ as meaning-utilizer and a neutral object or process of the environment as meaning-carrier, the formula of sign = meaning-carrier + meaning (meaning = dependence on the meaning-utilizer) only describes the first act of the 'drama' of meaning-utilization that follows. Here, too, the second act leads to the transformation of the meaning-carrier and shows that beginning and end of the drama are related to one another in a circle. When, as in the abovementioned example, the chlorophyll of the birch leaf (as meaning-utilizer) 'harpoons' solar energy (as meaning-carrier), a process is started in the course of which the meaning utilization again and again absorbs solar energy within organic substances, that is, the meaning-utilizer, here too, constantly extinguishes its meaning-carrier and tends to make the sign disappear.

## 9.2. *The sign process as the opposition of self and non-self*

For Uexküll the code that governs the life of the cell and ensures that it respond with its 'ego-quality' to all influences from outside (1970:116) is

the elementary sign. Or in other words: The most elementary sign process is the opposition of self (ego-quality) and non-self (non-ego-quality = external influence). The cell (as the meaning-utilizer) thus transforms every neutral influence into a meaning-carrier.

Life takes place, on every level, as variation and differentiation of these elementary sign processes, or to put this another way, each sign is a variation and differentiation of the opposition and linkage of self and non-self. This applies to the relationship between a plant and its dwelling envelope as well as to the relationship between an animal and its surrounding-world. The relation between hunter and prey, male and female, medium and medium user is in each case a variation of the basic melody, fundamental plan, or elementary code: self/non-self.

Thus one can already see that for Uexküll signs have a triadic structure. They consist of or develop from meaning-utilizer, meaning-carrier, and the code that defines the meaning and links both of them together. In the functional circle as the formula for sign processes on the stage of animal life there are the elements subject, object, and biological need that (as hunger, enemy, prey, medium, or sex) defines the functional circle.

A model for the opposition of self and non-self appears when one starts from the idea that in the functional circle effector organ (right through the subject) stimulates its own perceptual organ. 'Self' can then be interpreted as self-stimulation and 'non-self' as the variation of this self-stimulation through external influences. For the subject, which affirms its self through self-examination, these influences become non-self (T.v. Uexküll 1978).

### 9.3. *The problem of the inseparability of observer and observation*

The epistemologically fundamental problem, namely that all knowledge and every science is dependent on the nature of human cognition, is of *central importance in the field of semiotics, and is also relevant when dealing with the question of the priority of language.*<sup>15</sup> Uexküll concerned himself with the problem of language only casually. He was convinced that everything the observer can observe and all conclusions he can draw from these observations can only be perceived within the boundaries of his human experience; and human experience can only occur within the human surrounding-world.

Therefore it is absolutely essential to analyze first the structure, the anatomy, of the human surrounding-world before turning to an examination of the neutral objects which one encounters in this surrounding-

world. Uexküll confined himself to deducing our human representation of an objective external world from the biological reality of our surrounding-world by further adapting Kant's initiative to the field of biology.

However, he did not examine the question as to what language 'does' to a primarily biological human surrounding-world, what part it plays in constructing the representation of a world of physical reality. What nevertheless allows the question of the significance of language for man to be raised in a new way is Uexküll's concept of a gradual differentiation of the biological sign processes first from a vegetative to an animal stage, and next from the simple forms of life which Uexküll studied in the lower animals he described as 'realms of reflexes' (1980) to the complex ones which make use of a central nervous system.

#### 110. Concluding observations: Attempt at a comparison of Uexküll's, Peirce's, Saussure's, and Morris' theories of signs

In conclusion, I want to present some distinctions between biological and linguistic sign processes and try to relate them to the differences between Uexküll's, Peirce's, and Saussure's theories of signs and to make note of certain connections with Morris' theory of signs.

Biological sign systems differ from languages especially in two points:

1. The former are based on codes that are characteristic of the species and mainly innate. Thus one can describe them as 'natural codes'. The latter are based on culture-specific codes that have to be learnt and handed down from generation to generation, in short, on 'cultural codes'.
2. The schema for sign transmission differs in the two cases: It is dialogical in languages; a listener (receiver) receives signs from a speaker (transmitter). Both use the same culture-specific code. In biological sign processes the scheme is based on monologue. In the functional circle, the model for this scheme, the functions of receiving and transmitting are brought together within the subject. With the receptors the subject has the function of a receiver, with its effectors the function of a transmitter. This is added by the physical or chemical source of stimulation — in the form of the external world — as a kind of 'additional transmitter' which, however, as an 'objective connecting structure' semantically remains outside the sign process. Its function is confined to modifying the signs which the subject as transmitter sends out to its own receptors (T.v. Uexküll 1978) and in the course of which the fundamental process

occurs in which a self (as the meaning-utilizer) is complemented by a non-self (as the meaning-carrier).

The attempt to compare some of Uexküll's fundamental ideas to the corresponding concepts in Peirce's and Saussure's theories reveals some remarkable differences. Many of these can be attributed to the different types of problems which the three semioticians occupied themselves with. For Uexküll, who studies biological sign processes, the question of the relationship between the human observer and the biological subject under observation is of prime importance. For both he has to consider the development of signs in which hierarchic integration is of significance as well, as can be observed in the field of biology even between processes in the sensory organs (receptors) and those in the central nervous system (the perceptual organ). Another essential problem, which he has solved through the model of a circular process, is the relationship between sign and behavior (perception and operation).

These aspects are of little importance to sign-theories which take as their objects human language as well as the logical structure of reality. Since, however, language and thinking have a biological foundation and biological components, the influence of the latter must be traceable in its former.

An essential difference between the three theories of signs is the following: Peirce's theory of signs is triadic, Saussure's is dyadic, and Uexküll's is conceived as a cyclic process.

It appears to me that the relation between Peirce's triadic and Uexküll's cyclic model becomes obvious if the former is conceived of as a synchronic system, the latter as a model for the discursive stream of sign processes.

Another interesting insight is revealed by a comparison of Uexküll's theory of signs to that of Saussure. According to Saussure the function of a sign can be interpreted as the opposition and connection of two elements from two different classes, of which one element represents the *signifiant*, the other the *signifié*. Uexküll adds a second opposition: The system (or the class) of signs of the human observer, in opposition to the system (or the class) of signs of the organism under observation. All conclusions which respect to signs, as well as to the receiver (receptor) and the transmitter (effector) of the organism under observation, necessarily bear the mark of the human observer.

As to the sign system of the human observer, its space, consisting of our local and directional signs, as well as its system of physical relations, are of particular importance, once they reflect the relationships between our sensory and (voluntary) motor capacities. In Uexküll's terminology physical objects are meaning-carriers whose meaning refers to the motor

behavior of man (as the meaning-utilizer). The physical relations serve the human observer as a coordinate system in which he can ascertain and describe the relations of the organism under observation to its environment (to the surrounding-world of the human observer and its neutral objects). Therefore, the signs which he relates to the organism under observation as its perceptual signs are always taken from the observer's own repertoire of signs. But on the basis of the knowledge of the organization of the receptors and effectors of the organism under observation he can select those signs from this repertoire to which the living being under observation corresponds in its behavior, and then combine them with objects of the surrounding-world of the organism according to their significance for its vital activities.

Thus the neutral object of the observer represents a third element that is added as part of the semiotic chain to the *signifiant* and the *signifié* of Saussure's model and establishes the relationship between the human observer and the organism under observation. This third element represents the physical quality of the neutral object, which, as meaning-carrier, then establishes the connection between the physical sign system of the observer and the biological one of the organism under observation. Looked at from this aspect one can better understand why signs seem to have not only a dual structure (meaning-carrier + meaning), but so often also a dualistic structure of 'material' sign-carrier and 'immaterial' meaning.

The comparison of Uexküll's concept with Morris' theory exhibits some other possibilities of mutual complementarity:

Within the framework of Uexküll's model of the functional circle, perceptual and operational sign, and perceptual (characteristic feature) and operational cue, respectively, refer to one another as *signifiant* and *signifié*. Both receive their complementary meaning reference (as meaning-carrier and meaning-utilizer) from the biological 'tinge' of the functional circle (as the circle of food, enemy, sex, etc.), that is, the 'tinge' of the functional circle corresponds to the interpreting conscious mind. Each step of an action, and the action as a whole, follows the schema of the functional circle: Only when the perceptual cue has been extinguished by the complementary operational cue can a new perceptual cue initiate the next step of the action or finish the action.

Morris' theory (and that of George H. Mead as well) fails to consider the division of an action into perceptual and operational steps, and hence misses the circular principle of negative feedback. This is exactly what characterizes the enterprise of pragmatism. Instead, in Morris' model action as a whole is divided into phases of orientation, operation, and

satisfaction, the signs of which refer to one another and which likewise have a common meaning reference (interpretants) in the form of the 'impulse', which in the field of biology largely corresponds to the 'tinge' of Uexküll's functional circle.

At this point it would be useful to combine both concepts under the aspect of a 'double structure'. The functional circles, which describe the individual steps of an action according to the theory of signs, could then be interpreted as the elementary level, whose elements are combined by the 'impulses' to form the three phases of a higher-level action.

As the result of this comparative analysis the following statements can be made:

1. There is no alternative among the concepts of signs just analyzed, in the sense of one being more accurate or better than the other. They rather tend to complement one another. Each of them seems to emphasize a different aspect in a more comprehensive context.
2. The future task of general semiotics is to study and delineate this comprehensive context. Its objective — to use Uexküll's words — can be described as a theory of the composition of nature which also encompasses man and his sign system.
3. The contours of this future task become clearer if one differentiates four continents in the universe of sign systems according to the meaning-utilizers to be found there:
  - a. A continent of intracellular sign systems, in which cell organelles function as meaning-utilizers; the fundamental system appears to be the genetic code;
  - b. A continent of cellular and intercellular sign systems, which corresponds to the *endosemiotic* area, in Sebeok's terminology (1976). It includes the communication systems of unicellular organisms and cell assemblies (plants) at various levels of organization. Here it is finally the cells that are the meaning-utilizers.
  - c. A third continent can be seen in those sign systems in which organisms (animals) appear as the meaning-utilizers of meaning-carriers in their environment. Sebeok's *zoosemiotic* area (1976) would form a subcontinent here.
  - d. Finally, a fourth continent is indicated by those sign systems in which social groups rather than individual organisms can be identified as meaning-utilizers. The prototype of this system would be human language. Jakob von Uexküll's field of research was confined to the second and third of these continents, but his



initiative reveals its fruitfulness in reaching beyond the boundaries of his own field of research.

## Notes

1. The question as to the founders of ethology is too complicated to be dealt with in this context. See J. Jaynes, *Animal Behaviour*, 17 (1969), 601–606 among others.
2. Jakob von Uexküll and Ernst Cassirer were friends; whether and to what extent he came into contact with Peirce and his philosophical concepts must remain an open question. It is, however, not very likely, since Cassirer saw mainly the aspect of natural science in Uexküll's concept of biology, and not that of a sign theory. See also note 3.
3. This essential fact was clearly recognized by Cassirer, who writes: 'Biology, according to Uexküll, is a natural science which has to be developed by the usual empirical methods — the methods of observation and experimentation. Biological thought on the other hand, does not belong to the same type as physical or chemical thought. Uexküll is a resolute ... defender of the principle of the autonomy of life. Life is an ultimate and selfdependent reality. It cannot be described or explained in terms of physics or chemistry'. E. Cassirer, *An Essay On Man*, Yale University Press 1944.
4. The history of its development shows that in German mysticism the concept of *Gemüt* still referred to the whole inner world of man. Later a differentiation developed that resulted in dividing this inner world into its component parts and the term was more and more set in contrast to those areas it had previously encompassed, for example to the term *spirit*. (*Geist*) *Gemüt* was confined to the field of emotions and value-perception. In this form it was introduced into the German terminology of psychiatry and psychopathology. Following K. Schneider we speak of the 'gemuetloser Psychopath' meaning an 'abnormal personality' which is characterized by a lack of sympathy, shame, remorse, sense of honor, and conscience. Thus the term obtains a completely different meaning from the way it was used by Kant and Uexküll. In Kant's *Kritik der Reinen Vernunft*, *Gemüt* is defined as the essence and origin of the transcendental capacity of knowledge, as 'die gegebenen Vorstellungen zusammensetzende und die Einheit der empirischen Apprehension bewirkende Vermögen (animus)' (*Historisches Wörterbuch der Philosophie*, Bd. III, 1974, 259–267). Uexküll understands by *Gemüt* the synthetic function of apperception which combines the signs to form larger entities. It constructs the surrounding-world of the living being in its spatial and chronological organization and fills it with objects made up of organizing signs and content signs, and which are linked together by schemata (*Theoretische Biologie*, 1973, pp.11, 13, 117, etc.).

The concept of *Gemüt* has not been adopted by psychology and psychoanalysis, due to its numerous and often not very precise connotations. It is in just this context, however, that it would be useful to look for the links that exist, for example, between the concepts of emotional disturbance, imagination, and above all the ego and its functions on the one hand, and Uexküll's concept of *Gemüt* on the other. In this connection, H. Hartmann's definitions are of particular interest. He distinguished between defensive and synthetic functions and placed at the center of his observations a conflict-free zone of the ego. There are to be found here some concepts of great interest for genetic semiotics, which is concerned with the question of the formation of consciousness and consciousness of self.

5. In his essay 'Die Zahl als Reiz' Number as Stimulus, Uexküll examines how numbers can attain the meaning of signs in the surrounding-world of animals, and how they differ from the numbers used by man. *Tierseele. Zeitschrift für vergleichende Seelenkunde*, 1 [1913/14], 336–367; reprint 1980.
6. In a letter to Heinrich Junker of Berlin (in the collection 'Autographs' of the Deutsche Staatsbibliothek, East Berlin) Uexküll writes:

'I am convinced that you know much more about language than I do, which is evident especially in your fine paper on Wilhelm von Humboldt.

'Language interests me mainly as a means of communication between man and animals, and as a means of communication between animals themselves. Besides sequences of movement, sequences of sounds, the knowledge of which is innate, serve as a means of communication as well. Pheasant chicks can be raised by turkey hens, but not by ordinary hens, because pheasants understand the call and warning-cry of turkeys and answer them with appropriate behavior, but they give no heed to the ordinary hen's calling and warning. The turkey-language must be a dialect of the pheasant's language, whereas the language of ordinary hens belongs to an entirely different family of languages.

'Many animals are capable of using special sounds or sequences of sounds as secondary perceptual cues — Pavlov was able to demonstrate that dogs that were accustomed to listening to a special ringing of a bell before being fed started the secretion of saliva after this sign alone. Pavlov called this a "conditioned reflex". You can also utter the word "meat", instead of ringing a bell. Nevertheless, it is not possible to conclude from this observation that the dog understands the word 'meat'.

'A different approach was used in the experiment Dr. Sarris performed in the Institute for Umwelt-Research. A dog was trained to sit on a special chair after the command "Chair!" Then the chair was removed and the command repeated. Now the dog took its place on every object a dog could sit on. This observation can be expressed as follows: special objects have a "sitting-quality" for a dog. [More information on this can be found in "A Stroll through the Worlds of Animals and Men" by Uexküll and Kriszat (English version in J. v. Uexküll, 1957), and in E. G. Sarris, "The Umwelt of a Dog," in *Die Welt im Fortschritt*, Verlag Herbig, series 1, book 3.]

'For a dog the word "chair" does not have the meaning of a definite object but of a performance: to sit. This seems fundamental for language as a means of communication, between men as well. The spoken word, i.e., a definite sequence of sounds as a carrier of meaning, relates to a definite performance and not to a definite object.

Of the questions you asked me I especially took up those which are of personal interest to me. Linguistics itself is rather remote from my area, but I am convinced that you have set out on the right path by making it into a biological science'.

Sincerely yours,

J. v. Uexküll

7. It is open to speculation whether all language rules are acquired by learning or whether some are innate.
8. For Uexküll the question of how inanimate nature can be interpreted on the basis of life is posed, not however the reverse, how life can be interpreted from the perspective of inanimate nature. Since for man as a living being 'the inanimate' exists only on the basis of its differentiation from the animate and its relationship to the latter — only against the background of life — he can never take the inanimate or anorganic as a first point of departure which, as such, he knows nothing about.

Sebeok remarks in this connection: 'In other words, the critical feature of living

- entities and of machines programmed by humans, is *semiosis*'. (personal communication).
9. Sebeok's comment as to this point: 'This is the doctrine of *aliquid stat pro aliquo*, or what Jakobson recently dubbed *renvoi*'. (personal communication)
  10. Atom here is used in its original sense of 'that which is indivisible' — which indeed, like the physical atom, can be dissected into elements, but as a system represents a unity that can be dissected only at the expense of its destruction.
  11. This comment probably applies only to the unmusical semiotician. E. Leech (1978) considers music to be an even better paradigm than language, because in music metaphor (paradigmatic association, harmony) and metonymy (syntagmatic chain, melody) are permanently effective together. He says: The prototype of a general message-bearing system is not the line of type, but the performance of an orchestra where harmony and melody work in combination. His quotation of Lévi-Strauss sounds like an illustration of Uexküll's plan: 'The myth and the musical work thus appear to be the conductors of an orchestra whose audience is the silent musician'.
  12. The permanent presence of unconscious units of perception that ensure organization and relation 'beyond' the conscious perception of the succession of single impressions, which has been postulated here, appears at first glance to be just as unlogical as unlikely. We hardly have a concrete understanding of 'unconscious perception.' In the last few years however, characteristics of the human brain were discovered which support the assumption, initially considered to be improbable.

It has been known for a long time that the two hemispheres of the human cerebrum have different functions. However, as both are connected with many millions of neurons, which ensure an intensive cooperation, until recently but little was known about most of these functions. Since there have been a number of patients who — due to life-threatening epileptic fits — underwent a new method of operation, the severance of all connections between the two hemispheres, further details have broadened our knowledge. It was found that the functions of the left hemisphere, in which the center of speech is localized for all right-handed persons, are almost completely intact after the operation. The patients can write, solve arithmetic problems, speak, and think just as before the operation. But they can no longer perceive imagelike overall impressions and gestalt-like relations, and the right hand that is controlled by the left hemisphere is now incapable of expressing such relations. The right hemisphere, however, which is incapable of producing any acts of speech and thinking whatsoever, can do this, and the left hand controlled by it can structure these impressions even after the operation. But it is now unable to perform precision work, as the right can do even after the operation. Thus, it is assumed that the abilities of thinking in images and configurations, chronological arrangement, and comprehension of general pattern relations are localized in the right hemisphere. This also includes the musicality, which is affected by the operation as well. Apart from the capacity for speech, those for abstract analogies, chronological analysis, perception of details, and mathematical abilities seem to be localized in the left hemisphere. In healthy persons each of the two hemispheres appears to contribute its specific share in close cooperation with the other concerning the processing of information that arrives: The left hemisphere makes possible the perception of details, the analysis of the successiveness of impressions, and the ability to consciously reflect on it. The right hemisphere permanently accompanies this conscious perception against a background of unified and organization-producing structures and relations which, however, are beyond any conscious experience, as the right hemisphere possesses no capacity for speech.

An interesting hypothesis starts from the assumption that a different kind of con-

sciousness is localized in the right hemisphere, whose existence, however, remains hidden due to the lack of speech ability. There has even been speculation as to whether this 'speechless and thus unconscious consciousness' could be similar to animals, which are also speechless (Eccles, 1974).

13. Here a — or *the* fundamental — thesis of every theory of signs is formulated, namely that signs represent a unity or wholeness which consists of heterogeneous elements. This fundamental thesis can also be described as identity within difference or as a dialectic unity of opposing elements (Baer, 1983). In Uexküll's terminology this fundamental thesis means that each very sign represents a plan, a scheme, or a code according to which a meaning rule links together heterogeneous elements (as meaning-carriers and meaning-utilizers) in an overall unity.
 

In this way the vision of an infinite hierarchy is formed, in which the meaning rule (of the plan, scheme, or code) of a sign constantly links the meaning rules (plans, schemes, or codes) of signs that now become elements of the overall unity of the new sign. In the terminology of systems theory, one speaks of systems which are integrated as subsystems into suprasystems.
14. Baer very clearly illustrated this aspect in his chapter on Thomas A. Sebeok's theory of signs and brought out the connections to René Thom's theory of catastrophes.
15. Cf. the chapter on Thomas A. Sebeok's theory of signs, below.

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