

TN2834116

Introduction: Meaning and science in Jakob von Uexküll's concept of biology

THURE VON UEXKÜLL

Development and field of research

Jakob von Uexküll was born in 1864 in Keblas in Estonia. He studied zoology in Dorpat (Tartu, Estonia), and then worked at the Physiological Institute of the University of Heidelberg and at the Zoological Center in Naples. In 1907 he was awarded an honorary doctorate by the University of Heidelberg in recognition of his work in the field of muscular physiology. His later work was concerned with the problem of how living beings subjectively perceive their environment and how this perception determines their behavior. He founded a special method of research that he called '*Umwelt-Forschung*' (research into phenomenal worlds, self-worlds or subjective universes, i.e., the worlds around animals as they perceive them). In 1926 he founded the Institut für Umweltforschung at the University of Hamburg. He died in 1944 in Capri, Italy.

His field of research was, therefore, not language but the behavior of living beings and their interaction as cells and organs in the body or as subjects in families, groups, and communities. He is considered to be one of the founders of behavioral physiology (ethology), which was later developed most prominently by Lorenz and Tinbergen.¹

His particular interest was centered upon the fact that, in the origin and operation of processes of life, signs play a decisive role. He developed an original and integrated theory of processes of signs, which, however, was and is open to several misinterpretations, since it cannot be classified as belonging to any of the established sciences. We are concerned here neither with physiology nor even with behavioral physiology (although there are certain points of contact), nor with psychology, although subjects and their perceptual and behavioral activity occupy a central position. Neither can this theory be held within the boundaries that separate the natural sciences from the human sciences. He himself called his field of research 'biology', but his understanding of this term was not limited to the narrow field the word has now come to describe. He saw it

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as the science of the lives of plants, animals, and human beings.

Many of the misinterpretations can be overcome if we call his science 'general semiotics'. At the same time, it then becomes evident that general semiotics too stands between the boundaries of the established disciplines. A science that embraces natural systems of signs alongside and before the human system of signs breaks down our traditional division into natural sciences and human sciences. But the attempt to classify Jakob von Uexküll's science as general semiotics presents us with certain difficulties. Since he knew neither Peirce nor Saussure and did not use their terminology, his science cannot easily be classified as belonging to one of the known semiotic schools of thought.² For this reason it long remained unknown in the work of those semioticians whose theories developed out of linguistic research. Sebeok was the first to recognize his contribution to general semiotics.³

In order to understand why Jakob von Uexküll created his own terminology, we must consider the amount of reduction we produce in the phenomena of life by applying the terminology of the natural sciences. This starts with the prejudice that only physics and chemistry are capable of describing phenomena scientifically, but these have no terms for subjective phenomena (as, for instance, perception, feeling, and drive) or for subjects and the events that occur between them and between subjects and their objects. If we want to describe the role signs play in communication between subjects and between subjects and objects and if we do not have access to a generally accepted terminology of sign-processes, we are compelled to create a new terminology.

This produces special difficulties for all translators of Jakob von Uexküll's writings. For translation into English, Claire H. Schiller's comments are instructive. I will put them at the head of my exposition and my translations of Jakob von Uexküll's concepts.

The most puzzling terms are those by which v. Uexküll seeks to represent the relations between the objective world and the world as it appears to the animal. To deal with the latter he has coined a number of words which are almost untranslatable and much of his introduction is devoted to explaining their meaning. The term 'UMWELT' (self-world or phenomenal world) has been retained. It is the world around an animal as the animal sees it, the subjective world as contrasted with the environment. The effects of stimulation appear in this UMWELT as elementary sensations, MERKZEICHEN, which, organized and projected into the object, become meaningful perceptions, conceived by the animal as the properties of that object, MERKMAL. The perceptions are transformed in the nervous system into WIRKZEICHEN, the impulses to action. Action upon external objects modifies them to produce WIRKMAL, changes in the object which produce additional stimulation, translated as functional or effector cues. (J. v. Uexküll 1957: xiii)

The reader will find at the end of this book a special glossary, which contains the German terms of Jakob von Uexküll, their English translation, and an explanation. There the term 'action' is replaced by 'operation', and 'Umwelt' is transcribed as 'subjective universe'.

The differences in terminology, however, should not be seen only as creating difficulties — they also may prove helpful in throwing light upon areas where the various semiotic theories diverge.

What is *Umweltforschung*, research into phenomenal worlds, self-worlds, or subjective universes?

Having reached the negative conclusion that Umwelt-research is neither psychology nor physiology (not even behavioral physiology) nor biology (if we understand this only as molecular biology), we must extend this conclusion still further. In many philosophical dictionaries Umwelt-science is termed 'neovitalism' and thus labeled as a romantic nature-philosophy. This also leads to misunderstandings because we are concerned with research — empirical research that, in contrast to the so-called 'exact' natural sciences, however, has its own basic assumptions, its own methodology, and its own aims.⁴ I shall attempt to briefly outline these three points.

(1) The assumption that forms the basis of this science is a reversal of the classification of reality that is valid in traditional scientific theory. Reality, to which all things must yield and from which everything must derive, is not 'outside' in infinite space that has neither beginning nor end and that is filled with a cloud of elementary particles. Nor is it 'inside', within ourselves in the indistinct, distorted images of this 'outside' that our minds create. It reveals itself in the worlds (Jakob von Uexküll calls them *Umwelten*) with which sensual perception surrounds all living beings as if with bubbles that are sharply delineated but invisible to the outside observer. These 'bubbles of self-worlds' are, like Leibniz's 'monads', the bricks and mortar of reality.

This true reality (Jakob von Uexküll calls it *Natur*) that lies beyond or behind the nature that physicists, chemists, and microbiologists conceive of in their scientific systems reveals itself through signs. These signs are therefore the only true reality, and the rules and laws to which the signs and sign-processes are subject are the only real laws of nature. 'As the activity of our mind is the only piece of nature directly known to us, its laws are the only ones that have the right to be called laws of Nature.' (J. v. Uexküll 1973: 40)⁵

Since the activity of our mind (*Gemüt*)⁶ consists of the receiving and

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decoding of signs, the mind is, when all is said and done, an organ nature has created in order to perceive itself. So nature can be compared to a composer who listens to his own compositions, which he plays on an instrument he has created himself. There arises here, therefore, a strangely reciprocal relationship between nature, which has created mankind, and man, who creates nature, not only in his art and his science, but also in his subjective universe (Umwelt).

(2) The methodology of Umwelt-research, which aims to reconstruct this 'creating' of creative nature, can be termed 'participatory observation', if we define more precisely the terms participation and observation. To observe means first of all to ascertain which of the signs that the observer registers in his external world are received by the living being under observation. This requires an exact analysis of the sensory organs (receptors) of this living being. When this is accomplished, it is possible to observe how the living being decodes the signs it receives in the course of its behavioral activity. Participation means, therefore, reconstruction of the Umwelt of another living being, or the ratification of the decoding processes in its behavior after the enumeration of the signs the living being is capable of receiving, as well as the code by means of which it interprets the signs. 'Participation' is, therefore, not 'sympathetic understanding', and depth psychology would do well to employ this distinction with regard to its vague concept of 'empathy'.⁷

(3) The aim of Umwelt-research is to create a theory of the composition of nature, in other words, a score for the symphony of meanings that nature performs with the vast multiplicity of numberless Umwelts (subjective universes), as if playing on a gigantic keyboard on which our life and our Umwelt constitute but one of the keys.

Umwelt-research and linguistics

The formula for the reciprocal relationship between man, who must create nature, and nature, which has created man, requires us to consider the relationship between the sign-processes of nature and of language. In the first instance, Jakob von Uexküll was interested in one aspect of the relationship between Umwelt-research and the linguistic sciences — the question of the extent to which words, sentences, or numbers⁸ of our human language attain meaning as signs in the Umwelts of animals.⁹

The works of Peirce, Saussure, and Lévi-Strauss, whom Jakob von Uexküll did not know, force upon us a much more basic consideration. For that puzzling formula of reciprocal relationships for the relation between nature and man shows a surprising similarity to the formula the

linguistic sciences have drawn up for the relationship between language and man, when they state that man has created language, but language has formed man.

We are now faced with the basic decision as to how we should interpret this analogy between language and nature, between human and biological systems of signs or between linguistic laws and laws of nature. Is it merely a case of coincidental and superficial similarity? Is it the result of a romantic and anthropomorphic concept of nature? Or are we confronted with homomorphy, that is, a fundamental conformity repeated on various levels of complexity, each time in a different way but basically always in the same form, a conformity behind which there is perhaps a hidden genetic correlation?

If we accept the last alternative, then Saussure's distinction between '*langue*' and '*parole*' (or the more general one between code and message) appears to be an illustration of Jakob von Uexküll's distinction between active plan and concrete living existence: *langue* or code, when observed as a synchronous phenomenon, exists as an abstract system behind or beyond the *parole* or message, whose spoken words and sentences become a concrete manifestation for diachronic observation. The *langue* has no existence except in the step-by-step sequence of speech, but it determines every individual step. If we wish to discover something about the laws that govern the system behind our speech, then we must observe the *parole*, the concrete, spoken statements of men. This is analogous with the plan: 'Our mind possesses an inner plan that reveals itself only in the moment when it starts to be active. Therefore we must observe the mind during the time in which it receives and works out impressions according to its activity' (J. v. Uexküll 1973: 10); or 'the form is never anything else but the product of a plan imprinted on the indifferent materia that could have taken another form as well' (J. v. Uexküll 1973: 183).¹⁰

Both concepts — the concept of language (or code) and the concept of nature (or plan) — appear to be profound solutions to the old question about the priority of the chicken or the egg: chicken and egg, as concrete existences that follow each other in time, are only the manifestation of an abstract plan or system that lies behind them and actively determines every individual stage of development.

But there are important considerations that can immediately be raised against such an interpretation of the analogy between the laws of formation of the human and natural sciences. The laws of language are learned¹¹ and practiced by living subjects who are equipped with the necessary biological and mental prerequisites, i.e., brain, memory, larynx, and vocalization, as well as historical past in a culture in which the language arose. All this is missing in the laws of formation that lie behind

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the metabolism and differentiation of cells in the formation of living beings and behind their reactions to stimuli. Would such laws not, of necessity, unhinge the laws of natural science, which govern the behavior of molecules, membranes, and processes of diffusion?

The problem of the sign-receiver, the law of 'specific life-energy', and the 'elementary self'

This objection does not hold for Jakob von Uexküll, since it could also be made against the existence of the laws of the human sciences. But nobody would in fact maintain that language does away with the laws of physics, chemistry, and molecular biology about sound waves, processes in the inner ear, or in the auditory nerves, etc. But these laws do not suffice to explain how education comes into being within the framework of human culture. Here we can be directed by the laws of formation of the linguistic sciences, which are valid for living people, who are concerned with processes of signs that bear meaning and sense, but not or not only with physical and biochemical processes, as is ostensibly the case in the field of biology. At this point two observations must be made that are essential for the understanding of 'Umwelt-theory'.

(1) Umwelt-theory maintains that the laws of natural science are not laws of nature, but rules that we derive from our confrontation with nature for our human aims. This in no way denies their validity; it merely makes the claim that they are only valid for nature under the condition that we are at the same time conscious of the contribution of our human senses and our efforts of abstraction.

(2) Umwelt-theory does not make a distinction between nature and man, but between living and nonliving nature. The laws of formation it postulates with the nature-plans, which reveal an analogy to the laws of formation of language, are valid only within the field of living organisms.¹²

The aim of Physiology is the reduction of biological processes to problems of Physics and Chemistry ... The basic phenomena of tissues, as for instance the contraction of muscles, serve for it as starting point in order to reduce the manifestation of life to the laws of the inorganic world, bringing into play processes of electricity, osmosis and so forth. Just the opposite is the way of Biology ... the bricks are ... biological elements [through the collaboration of which it tries to understand the life of the whole organism]. Therefore the problems of the relation between living and inanimate nature are not its concern. (Insertion in brackets added by the editor.) (J. v. Uexküll 1902: 229)¹³

The division between living and nonliving nature is not made on the basis of secondary features of distinction such as chemical make-up, size, complexity, or form of the structures in question, but on the basis of a peculiarity that is found in all and only living organisms, even in the simplest forms of life — the single-cell organisms. This peculiarity is the ability of an organism to respond to impulses from outside not in a causal-mechanical way, but with its own specific reaction. From this point of view all living organisms are autonomous, while all nonliving organisms, including our commodities and machines, must remain heteronomous. This characteristic, which defines unambiguously the distinction between living and nonliving entities, was first described (as Jakob von Uexküll emphasizes) by Johannes Müller, a contemporary of Goethe: 'The sense-impression is not the transmission of a quality or a condition of the outer objects to the consciousness, but the transmission of a quality or a condition of a sensory nerve to the consciousness induced by an outer cause, and these qualities are different in the different sensory nerves, the sensory energies' (Müller 1840: 254).¹⁴ Jakob von Uexküll, emphasizing this finding, says:

One hundred years ago Johannes Müller laid down the doctrine, which is maintained by contemporary physiology as a mere torso: that every organic substance (meant as: living being) reacts quite differently upon influences from outside than an inorganic substance spread in space. Every inorganic body, be it a mere conglomerate of parts without any relation to each other or a machine, distinguished by an artfully designed plan, reacts upon the outer world completely differently than every organism or every organ consisting of living cells, because every living cell is autonomous and not heteronomous.

If a machine, let us say a motor car, is exposed to outer influences of a chemical or physical nature, it will react as a whole only when a trigger is pressed. Then it moves away. Under any other circumstances it reacts in the same way as a heap of iron; its parts will get out of place if it is pushed, get warm if it is heated, become rusty if moistened with acids. A muscle reacts in quite a different way, as Müller pointed out. It reacts to every outer influence of a mechanical, electrical or chemical nature never like a heap of isolated parts but always as a whole — a muscle — with contraction. This Müller called its specific energy. The word energy had in those times the meaning of energy of life, i.e. an immaterial factor that has nothing to do with physical energy. Specific energy is not at all subject to the much later discovered law of conservation of energy. We could call it 'entirety-energy', which can never be transferred. (J. v. Uexküll 1931a: 208–209)¹⁵

This means nothing more than the fact that living organisms (including cells) respond as subjects, i.e., they respond only to signs and — as long as they remain alive — not to causal impulses.¹⁶ Since all living organisms consist of cells, their development as well as their coming to grips with

their surroundings in later life can only be understood as responses to signs. It can also be said that all living organisms encode physical or chemical stimuli into signs.

In stressing the autonomy of every living organism we are brought to another conclusion. A sign never exists in its own right; it is always part of a circular process in which a receiver (receptor) receives stimuli, codes them into signs, and responds to them as such.

The most elementary process of signs, the 'semiotic atom' so to speak,¹⁷ is the living cell, which imparts its own specific meaning to every impulse to which it responds, encoding according to its specific code and then reacting with its specific response. Thus for the first time a quality appears in nature that we term 'self' or 'specific', i.e., the ability of an organism to transpose 'nonself' into 'self'. Müller's specific energy defines the 'elementary self' in semiotic terminology.

As soon as it is clear to us that Umwelt-research explores the sign-processes that govern the behavior of living subjects (even of cells), we can see that in fact there is a genuine analogy between linguistic and biological laws of formation that in the final instance removes the distinction between the human and the natural sciences. That is to say, if we understand under the term science the attempt to identify the factors that determine the behavior of phenomena with respect to each other and to ourselves, then the distinction between human and natural sciences becomes untenable for a theory of signs.

Therefore, we may compare concepts such as system, structure, unity, etc., which the linguistic sciences provide, with the concepts of Umwelt-theory because the linguistic concepts illustrate the concepts of Umwelt-theory as precisely as the musical examples Jakob von Uexküll employed in the first instance.¹⁸

The 'private' nature of signs

There is one peculiarity of sign-processes that has still to be considered. It too is of fundamental importance to our understanding of Umwelt-theory, and not only in this particular instance, but for every theory of signs.

Every sign is, we may say, in the strictest sense of the word 'private' — or to put it differently, there are no objective signs, there are only sign-systems with the same structure and the same code for different receivers of signs. This conclusion is merely the reverse side of the autonomy of living organisms. What each sign means to the subject as receiver is registered only by that subject itself, or, as Jakob von Uexküll states: 'A

living cell possesses its own ego-quality [*Ich-Ton*] (J. v. Uexküll 1931a: 209).¹⁹

This conclusion has far-reaching consequences that can be brought under the heading of the inescapability of the experience of self, if we understand by this the conclusion that to a varying degree and in various forms worries all philosophers, namely, that in everything we experience, we simultaneously experience ourselves. Jakob von Uexküll referred to Kant when dealing with this basic problem:

To the craving for enquiry of the naive observer to explore all the bodily phenomena in his environment and to explore the influence they have on each other, Kant calls a categorical 'Stop!' Before you start exploring the essence of the things that surround you, investigate first what you yourself as a subject carry into nature. Before judging the things you look at, examine your own perception. And now he is taught by Kant that Space and Time are not objects which could be taken out of the multitude of other objects and then be looked at and touched, but that they are the forms of our perception. As soon as we turn to observation of nature, we necessarily carry space and time as elastic frames into our observation. They embrace all the phenomena that are present, and we classify into them all things, big and small, near and far away, past and future. The qualities of all things, Kant teaches us, are not their own, but are only our perception projected outwards by our imagination. Just as far as the treasure of our sensations reaches, so far reaches the treasure of qualities of all things. (J. v. Uexküll 1947: 6-7)²⁰

In other words, what we experience of nature is colored by our experience of ourselves, or:

'All reality is subjective appearance'. This has to be the great, fundamental understanding also of biology ... With this understanding we tread on old and safe ground, prepared by Kant in a unique way to carry the edifice of all natural science. Kant has put the subject, man, in opposition to the objects and has discovered the fundamental principles according to which the objects are formed in our mind.

The task of biology is to widen the results of Kant's research in two directions: 1. to take into account the role of our body, especially of our sense-organs and our central nervous system and 2. to explore the relations of other subjects (the animals) to the objects. (J. v. Uexküll 1973: 9-10)²¹

With these two requirements, Jakob von Uexküll outlines the scope of his sign-theory. It proceeds from the assumption that we must first examine the 'primary receiver' of signs, namely, ourselves or our minds, and that we can only then place other subjects, above all, animals, in the role of receivers of signs.

The construction of the human subjective universe as a composition of sign-processes

Preliminary note The basic conception that life on the elementary level is borne by cell-subjects, which in their existence as autonomous units transpose all stimuli into subjective (private) signs — their expressions of self or their ego-qualities — and which react only to these signs, implies the necessity of solving two problems:

(i) It demands the working out of a new 'anatomy', in which is represented the manner in which the higher forms of life with their complicated achievements are formed from the combination of cell-subjects and their elementary sign-processes. This 'anatomy' must first dissect the subjective Umwelt of the researcher himself. It must ascertain how this is constructed from the elementary achievements (processes of signs) of the cells and organs of his body.

(ii) At the same time it implies the necessity of representing how the 'objective outside world' in which we observe ourselves and other living things arises out of our subjective (private) universe (our Umwelt), that is to say, how the former is derived from the latter as an abstraction. This problem can only be solved by epistemological biology or biological epistemology, in other words, biology and epistemology united.

Not until this twofold task is realized can the true task of Umwelt-research be tackled: to construct from the discoveries we have made regarding the construction of our human subjective universe a model for the construction of the subjective universes of other living beings (their Umwelts).

Jakob von Uexküll's analysis of the human mind as a sign-receiver and its method of work in the construction of our subjective universe, as explicated in his *Theoretische Biologie*, uncovers a structure or 'anatomy' whose analogous nature to the structure of language is staggering. Just as language has signs on different levels of integration (phonemes, words, sentences, etc.), so the analysis of our phenomenal world reveals different levels, on which processes of signs of differing complexity can be examined. On each of these levels we can again recognize surprising analogies between these signs and the signs of human language.

The elementary processes of signs On the elementary level we come across two classifications of sign-processes: the organizing signs (*Ordnungszeichen*) and the signs of content (*Inhaltszeichen*). Both are mediated by specific sensory cells (such as receptors).

The organizing signs, which are to be considered first, may be described as the self-expressions (the ego-qualities) of cells that are distributed either

as tactile cells in the skin on the surface of our bodies or as specific perceptive cells in the retinas of our eyes. They respond to all stimuli by means of 'local signs' (*Lokalzeichen*), which we experience as 'places' or localities (*Orte*) in our external world. A mosaic of 'places' (localities) (*Orten*) thus arises as an organizing framework.

If two tactile cells in the skin or perceptive cells on the retina are stimulated one after another in such a way that the ego-quality of the first cell is fading in strength while that of the second becomes stronger, then a new sign is created — the 'directional sign' (*Richtungszeichen*), which connects two localities in our external world by means of a movement. Local signs and directional signs can only represent a two-dimensional surface of localities. A shift into depth, and thereby into the third dimension, is brought about only by the involvement of active muscular movements that shift the surface of the skin (above all on the arms and hands) that bears the tactile cells, or that alter the degree of distortion of the optical lens. Here, however, our bodies require information about the impulses that set the muscles into action.

The signs responsible for this information are 'impulse-to-operation signs' (*Wirkzeichen*), which arise as return information of voluntary innervations of the muscles for active movement, before the completion of the movement. The impulse-to-operation 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 such messages for feedback lines in the construction of a centralized control system, which forms the basis for phenomena such as will and consciousness and for the formation of an ego, is only mentioned here in passing. In general semiotics, however, their significance can hardly be overestimated.

Within the framework of Umwelt-theory, another aspect of the impulse-to-operation signs is emphasized. As signs for our voluntary intentions, they are independent of external experience. This fact explains the ability of our minds to develop the concept of space (which frames our subjective universe in its stable order) without the aid of external experience. Space is thereby revealed as a 'significant component of our (sensory) organization, and as such a true law of Nature that is both subjectively and objectively valid' (J. v. Uexküll 1973: 39). This is considered to be the reason for the apriority of space.

The same is true of time, whose elementary sign appears as a 'moment', i.e., the briefest time unit within which the world shows no change. In contrast, however, to the case of elementary signs that constitute space, it has not yet proved to be possible to trace specific cell-subjects that act as mediators for these. Moments are thus conceived of as signs of the

synthetic function of our mind that is divisible into phases, and of apperception as a process of life (see J. v. Uexküll 1973: 70).

Local signs, directional signs, and impulse-to-operation signs, together with time signs, construct space and time in our subjective universe. Because they give it its ordered framework, which embraces all other signs as its content, they have been called organizing signs. They are 'die Ordner der Welt' — the organizers of the world (see J. v. Uexküll 1973: 111).

If we now turn to the 'signs of content' — the colors, sounds, smells, etc. — these too can be related as specific expressions of self or ego-qualities to certain cell-subjects. In the higher life-forms these are concentrated in the sensory organs or receptors (eyes, ears, nose, etc.)

Within the framework of the complex organization of our bodies, the sensory cells are connected by nerves to certain regions of our brain. Their expressions of self — ego-qualities — are thus tied to the functioning of a chain of encoding and decoding processes in consecutively activated cell-subjects. But the cell-subjects in the periphery of the sensory organs are not only involved at the beginning of these processes, they also start them with their subjective responses to stimuli. We are therefore justified in conceiving of them as elementary constituents of our sensory organization, and of their ego-qualities as elementary sign-processes.

The codes of the elementary sign-processes We are now concerned with the examination of the analogies between the regularities that appear on the level of the elementary sign-processes and the regularities of linguistic science. On this level, three aspects immediately come to our attention that are strikingly similar to the aspects Charles Morris (1971) identified in signs. It seems to me to be of particular interest to general semiotics that there are two scientists who, without knowledge of each other, from totally different starting points, with very different objectives, and in completely different subject areas, developed the concept of signs and ascertained identical regularities. Morris distinguished between the syntactic, the semantic, and the pragmatic aspects of signs. These three aspects can also be found in Jakob von Uexküll's elementary sign processes.

(i) The syntactic aspect, which is concerned with grammatical rules according to which signs follow each other, presupposes a diachronic observation (see above). It is relatively less evident on the biological elementary level. Nevertheless there are such rules, for example in the case of the after-images of colors, which are probably traceable in similar fashion in other sensory signs as well. They are most obvious in sounds, in the field of music.

(ii) The analogies are far more noticeable as soon as we look at the semantic aspect of processes of signs. We find first of all that all signs reveal a 'höchst merkwürdige Verwandtschaftsordnung' (a highly remarkable organization of kinship) (J. v. Uexküll 1973: 13). Thus there is a kinship-organization in the field of color qualities that is responsible for the fact that every individual color has a strict relationship with all the other colors. This kinship-organization can be represented graphically as a hexagon or a chromatic circle. The kinship-organization for sounds may be illustrated by a scale of sounds, that for smells as a scale of smells. The same applies to heat, hardness, taste, etc.

These systems of kinship — and this is the exciting thing about them — are always unconsciously perceived whenever an individual sign turns up. For example, whenever we observe the color red, we always see that it is not green, yellow, or blue, but that it stands in a strictly ordered relationship to all those colors we do not see at that particular moment. We also see the intensity of a particular 'red' in terms of the scale that delineates all intensities from the palest to the deepest red, and that is equally invisibly present. The same is true of sounds. Simultaneously with the perception of every single sound, we perceive the, as it were, silent scale of all other sounds and their gradations of intensity. This is also true of the perception of heat, smell, touch, and taste.

The fact that whenever we perceive an individual sign we unconsciously perceive at the same time every other sign that belongs to the same system shows that (in the terminology of the linguistic sciences) the diachronic sequence of the individual signs is always embedded in the synchronous background of the system and its structure — or that the unified Gestalt of the system is present unconsciously but with a determining influence in the sequence of the signs. Just as in Saussure's example, where 'chess' as a system with its abstract rules and relationships governs every move made in an actual chess game, so the individual sense-systems with their kinship-organization have the power to create color, smell, tactile, and taste signs. The creative power Saussure recognizes in language as *langue* is termed 'plan' in biology by Jakob von Uexküll. Every individual sign is, like the tip of an iceberg that appears above the surface of the water, only a part of the hidden totality or systematic arrangement of a system of signs (see Hawkes 1977: 21).

The semantic aspect of the regularity or systematic arrangement that is expressed in the kinship organization is revealed in the ability of the system to define itself and its elements independently and, as it were, completely arbitrarily. The quality, i.e., the semantic significance (red, yellow, green, or blue) of every color is defined only on the basis of its relationship within the unified system of the scale of colors. The same is

true of all other sensory signs — such as sounds, whose quality of significance is determined by the scale of sounds, or heat, whose quality of significance is determined by the temperature scale, etc.

This unconsciously perceived order of all signs belonging to the same system (or their structure of meaning), which is recognized simultaneously with the perception of every individual sign, has an interesting consequence in the case of the organizing signs. The fact that we know where to locate every local sign that results from our skin being touched or the stimulation of a point on the retina, within a space that surrounds us and of which our bodies also form a part, that we know whether it is at the top or at the bottom, on the right or on the left, at the front or at the back, proves nothing more than the fact that we, as semantic systems of local signs, continually carry 'space' with us. We also carry with us a similar potential order (from which we cannot escape however hard we try): time. Time is the semantic system of the moment signs, which are arranged on a scale on which a 'present' is always situated between a past and a future.

Semantic systems for the signs of content, as well as semantic systems for the organizing signs with their regular structures, are abstract formations. But they create the concrete signs, which have meaning only as elements of the semantic system to which they belong and in terms of their relationship to the other signs in the same system. Signs draw attention to something beyond themselves and to something that is not themselves. On the level of the elementary processes of signs, this is the kinship-organization with respect to the other signs of the same semantic system.

The closed character of the semantic systems of biological elementary signs, the fact that they are complete within themselves, self-defining, sufficient unto themselves, that they are, as it were, only 'inwardly' but not 'outwardly' secured, is the precondition upon which depends their ability to be coupled on a more complex level with the signs of other semantic systems.

(iii) No less remarkable is the pragmatic aspect of signs in Umwelt-theory. This aspect can be seen from two different points of view.

The first is concerned with the distinction made by Jakob von Uexküll between 'perceptual sign' (*Merkzeichen*) and 'perceptual cue', or property of an object (*Merkmal*). Every perceptual cue, as property of an object, is a perceptual sign that has been projected to the outside. To put it in another way, while the perceptual sign occurs as the ego-quality of a sensory cell in the subject, the perceptual cue is outside in the external world:

No matter what kind of quality it may be, all perceptual signs have always the form of a command or impulse ... If I maintain that the sky is blue, I am doing so because the perceptual signs projected by myself give the command to the farthest

level: *Be hinaus!* ... The sensations of the mind become, during the construction of our worlds, the qualities of the objects, or, as we can put it in other words, the subjective qualities are building up the objective world. If we, instead of sensation or subjective quality, say perceptual sign, we can formulate: the perceptual signs of our attention become the perceptual cues (properties) of the world. (J. v. Uexküll 1973: 102)²²

For the local signs, which we receive on the surface of our bodies, in the skin or on the retina, this command or impulse says: *Be outside!* at this particular point in space, which has been transposed in this way to the outside as a command. The expression '*hinausverlegt*' (projected to the outside), which occurs again and again in the works of Jakob von Uexküll, can only be understood from this standpoint — that is, under the pragmatic aspect of the local signs.

The second point of view supplies us with an answer to the question that is of central importance in scientific theory: how do we derive the representation of an objective world with its physical characteristics from our subjective universe, while at the same time answering the question as to what this world that is the basis of our scientific observation means for us and our subjective universe? Here we must pay attention to the overlapping system and its structure of relationships, in which all organizing signs are allied to each other and to our impulse-to-operation signs. We can then see that the phenomenal space, which consists of the tactile space (of the local signs of the skin), the visual space (the mosaic of local signs of the retina), and the operational space, reflects the basic scheme for all programs that connect our sensory perception with the possibilities of our active motor involvement. From a biological point of view, energy and matter are only general programs that connect our sensory perception with the possibilities of active motor involvement.

Any colored area of our visual space, of whatever kind it may be, forms a barrier, which is near or far away — all arouse the same sentiment, namely that of an obstacle like the resistances felt by our touching hand. In that way they obtain the character of matter, which has, generally speaking, no other meaning than that of a real barrier. The result is that we call matter everything that proves its reality by being a barrier. (J. v. Uexküll 1973: 61)²³

What is true of matter is also true of energy:

... Energy is originally nothing but a sensation that is connected with the movement of our muscles. By an uncontrolled conclusion we take this muscle-sensation as the origin of the movement of our limbs and then convert it into the origin of every movement in general ... The reduction of the material processes in

space to the local signs and direction signs has proved without any doubt the subjective nature of these phenomena as well and therewith clearly classified the position of the so-called objective Natural Sciences as belonging to the realm of biology. (J. v. Uexküll 1973: 64–66)²⁴

This means nothing less than the fact that by the consistent abstraction of all signs of content and features of content the natural sciences construct a mental image of a world in which only the organizing signs are taken into consideration. This is the solution to the second of the two tasks formulated above. The significance of this abstraction leading to a mental image of an objective world as parameter for the cooperation of various human subjects and thus for the construction of a human culture is clear.

The complex levels or the combination of the sign-processes The connection of the processes of signs with cell-subjects (as their ego-qualities) has the advantage that the parallels between the complexity of signs and the complexity of construction of the sensory organs in higher life-forms becomes obvious. Even the combination of organizing signs and signs of content, or more precisely, the mutual alliance of local signs and impulse-to-operation signs in our subjective universe — an alliance on which our conception of an objective outside world is based — depends upon the existence of complicated nerve-connections between the receptor cell-subjects and switch-arrangements in the central nervous system. We are thus confronted with the problem of how the complex signs come into being that fill our subjective universe in the form of objects and processes and that, in the *Umwelts* of all higher life-forms, serve the purpose of orientation, which is just as important as navigational aids are to a seaman. What does the ribbon look like that joins the elementary organizing signs and signs of content to the clearly delineated objects and processes 'which we see everywhere around us and the unity of which we perceive without any doubt about it?' (J. v. Uexküll 1973: 116).

If we observe the activity of our mind during the construction and recognition of objects and processes in our surroundings, then we may ascertain that it is not static memory-images that are used. Instead, the process of image-formation itself is repeated and the sequence of impulses for the movements of our muscles (for example, when following the contours of an object with our eyes or with the hand) is thereby compared with programs of sequences of impulses that are stored in our memories. With reference to Kant, Jakob von Uexküll calls these programs 'schemata': 'Like the rigging-loft of a theater with wings, so our whole memory is filled with schemata, which from time to time appear on the stage of our consciousness' (J. v. Uexküll 1973: 121).²⁵

The private nature of the signs, which we have already emphasized in

the case of the elementary processes of signs (the perception of a color, a sound, or a taste is a strictly subjective, private experience), is equally shared by the complex signs, which we construct with the aid of the programs or 'schemata'. The table, the house, and the tree that I perceive belong to my phenomenal world and are not identical with the table, house, and tree my fellow human perceives.

Unfortunately we have no access to other people's stages of consciousness — nothing could be more instructive than the possibility to look at the world through other people's schemata. But one thing we should never forget: If we see our fellow creatures walking around, they walk on our stage, while we move on their stages. These stages are never identical, in most cases they are even fundamentally different. We cannot claim to play the same role on the stages of other people as we do on our own stage. (J. v. Uexküll 1973: 121–122)²⁶

It is also possible on this more complex level to consider signs from a syntactic, semantic, and pragmatic aspect. And if we do, it becomes clear that the abstract systems that we perceive simultaneously as synchronous structures used in the background of every complex sign are completely different from those on the level of the elementary processes of signs. These systems are now the units of biological operations. In Umwelt-theory these are termed 'circles' (*Kreise*), and contrasted with each other as circles representing the systems of food, of enemies, of the sexual partner, and of the medium.

In each of these circles a 'syntactic organization' ensures that the chronological sequence in which signs occur corresponds to the cues of the operation in question. Thus, according to the intrinsic logic of the operation every newly occurring sign establishes relations with the previous one and prepares the way for the next.

The 'semantic organization' ensures that every sign reflects the special need that separates one particular 'circle' from all the others. Thus the same object could represent a meal in the food-circle, a danger in the circle of enemies, or an obstruction in the circle of the medium, changing its meaning according to the situation.

In the 'pragmatic organization', signs are instructions to operate. They tell the subject (as navigational aids do the seaman) what is to be done, i.e., they give instructions on how to operate.

The functional circle as formula for the dynamic unity of the processes of life — the process of signs as a whole

I have attempted to outline broadly the way in which Umwelt-research applies its method of participatory observation to the researcher himself.

In conclusion I would like to briefly present the model constructed for the examination of other living beings as a result of this self-analysis.

Until now, participatory observation has meant that the observer observes himself (his mind) as part of closed sequences of events, the processes of life. From the analysis of these sequences of events the following elements were isolated, their functions determined, and thus the unity of the sequences of events was structured:

(1) The receiver or receptor is on every level a living subject, i.e., distinguished (and defined) by the ability to transform 'nonself' into 'self' in its infinite differentiations.

(2) The task of signs is to form a connection between 'self' and 'nonself'. According to their definition, signs draw attention to something that is not themselves. In other words, they translate 'self' into 'nonself' and vice versa. Receptor-signs (ego-qualities or 'self') translate stimuli (influences from outside or 'nonself') into perceptual cues ('nonself' in its meaning for the 'self'). Therefore signs always occur as processes of signs.

(3) These proceed according to rules that are at the disposal of the sign-receiver (in the form of an inborn or acquired repertoire). In Umwelt-theory these rules are termed 'sequence of impulses', 'melody', 'scheme', 'plan', or simply 'rule'. I suggest that they should be commonly termed 'code' in order to make clear their analogy to the rules of language.

(4) The 'sender' or the source of the stimuli occurs in two forms:

(a) as 'nonself', with all the pitfalls of cognition theory this implies. As the opposing element to the receiver and its subjectivity, it is a model of the 'nonsubjective' and 'nonprivate' that can be conceived of as a common source of stimuli in common surroundings, and that emits ('nonsubjective' and 'nonprivate') carriers of signs, which are then encoded by the receivers into subjective signs according to their particular code.

(b) as 'self'. In elements 1,2,3, and 4a only a part of the unity of the process of life as a system of opposition of 'self' and 'nonself' is portrayed — and that part is the process of perception (*Merken*). The other part, whereby the receiver himself becomes a sender, is termed by Jakob von Uexküll 'operation' (*Wirken*). It occurs in the form both of utilization of signs and of supervision of the correct interpretation (coding of 'nonself' into 'self') by feedback.

If we run through the various phases of this self-analysis, we come upon the model for the observation of other living beings constructed by Jakob von Uexküll — the functional circle. (See Figure 1, p. 32).

In this, the subject (as 'self') embraces the object like a forceps with its two claws: on one hand as receiver (receptor), which receives stimuli and transposes them into signs, thus structuring the 'nonself' with perceptual

cues (properties of an object); on the other hand as operator (effector), which changes or erases the perceptual cues or properties of the 'nonself' with operational cues. We can reduce this process to its simplest form by describing it as 'self-stimulation' that is modified by the alternation of the 'nonself' between stimulating operator (effector) and stimulated receiver (receptor).

This model describes sign-processes in the framework of the context of life-processes, whose theme is on every level the drama of the opposition and feedback of 'self' and 'nonself'. It permits the researcher to analyze the rules or inner logic that govern the construction of organisms and the relationship of living beings to their surroundings and their fellow beings. The revelation of these rules serves the purpose of drawing up a theory of the composition of nature.

Notes

1. The question as to the founders of ethology is too complicated to be dealt with in this context. See Jaynes (1969).
2. Ernst Cassirer was a friend of Jakob von Uexküll; whether and to what extent he came into contact with Peirce and his philosophical concepts as a result of this friendship is a question that must remain unanswered. It is, however, improbable that this situation did arise, since Cassirer saw above all the aspect of natural science in von Uexküll's biology, and not that of sign-theory. See also note 4.
3. 'Neglected figures in the history of semiotic inquiry: Jakob von Uexküll', lecture given at the III Wiener Symposium über Semiotik, Vienna, August 27th, 1977. (It can be found in Sebeok 1979: 187–207). Under the keyword 'Biosemiotic' Stepanov mentions Jakob von Uexküll as someone who occupies a 'special place' (1971: 27–32).
4. Cassirer clearly recognized this centrally important fact. He 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 autonomy of life. Life is an ultimate and self-dependent reality. It cannot be described or explained in terms of physics or chemistry.' (Cassirer 1944: 23).
5. 'Da die Tätigkeit unseres Gemüts das einzige uns unmittelbar bekannte Stück Natur ist, sind seine Gesetze die einzigen, die mit Recht den Namen Naturgesetze führen dürfen.' Unless otherwise noted, translations from the German are my own.
6. The concept '*Gemüt*' is difficult to translate; the term 'mind' does not exactly cover its meaning. The history of its development shows that in German mysticism it represented the complete inner world of man. Later there arose a differentiation whereby this inner world was divided into its component parts and the term was more and more used as a contrast to those areas it had previously encompassed, for example, 'spirit'. *Gemüt* became limited to the field of emotions and value-perception. In this form it entered into the German terminology of psychiatry and psychopathology. Here we may speak, in Schneider's terms, of a '*gemütlosen Psychopathen*', by which he meant an 'abnormal personality' who is characterized by a lack of sympathy, shame,

remorse, sense of honor, and conscience. The concept thus acquires a completely different significance from that which it had when used by Kant or von 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 Apprehensionen bewirkende Vermögen (animus)' (*Historisches Wörterbuch* 1974: 259–267).

Jakob von Uexküll uses the concept *Gemüt* (mind) to signify the synthetic function of apperception, which joins signs together to form larger entities. It constructs the Umwelt of the human being in its spatial and chronological texture and fills it with objects that are made up of organizing signs and signs of content, which are connected by a scheme, as by a ribbon (J. v. Uexküll 1973: 11, 13, 117, passim).

The concept *Gemüt* has not been adopted by psychology and psychoanalysis because of its numerous and frequently not precise connotations. However, this is the very context in which it would be useful, for example, to pinpoint the connections that exist between the concepts of emotional disturbance, imagination, and above all ego and functions of the ego, on the one hand, and Jakob von Uexküll's concept of *Gemüt* (mind) on the other. In this connection, Hartmann's definitions especially arouse interest. Hartmann made a distinction between defensive and synthetic functions and placed at the center of his observations a conflict-free zone of the ego. There are some highly interesting approaches to be found here for genetic semiotics, which is concerned with the question of the formation of consciousness and consciousness of self.

7. Jakob von Uexküll stresses again and again that psychological methods of research, inasmuch as they are concerned with 'sympathetic understanding', run counter to the direction of biological research (J. v. Uexküll 1973: 167).
8. In his essay 'Die Zahl als Reiz' ('Number as stimulus'), Jakob von Uexküll examines the form in which numbers can attain meaning as signs in the Umwelts of animals, and in what way these differ from human numbers. (See J. v. Uexküll 1913/14.)
9. In a letter to Heinrich Junker, in Berlin (from the collection 'Autographa' of the Deutsche Staatsbibliothek DDR—1086, Berlin), Jakob von Uexküll writes:

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

'Language has interest for me mainly as a means of communication between man and animals, and then as a means of communication between the animals themselves. Besides sequences of movements, sequences of sounds, the knowledge of which is also inborn, serve as 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 could demonstrate that dogs that were accustomed to listen to a special ringing of a bell before being fed started the secretion of saliva after this sign alone. Pavlov called this "conditioned reflex". You can, instead of ringing a bell, also utter the word "meat". Nevertheless, it is not possible to draw from this observation the conclusion that the dog understands the word "meat".

'Things are different 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. We express this observation by stating that special objects have a "sitting-quality" for a dog. (You will find more of this 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*, vol. III.)

The word "chair" has for a dog the meaning not of a definite object but of a performance: to sit. This seems to me fundamental for language as a measure for understanding, 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 took up especially those which are of personal interest to me. The linguistic science itself is far from me, but I am convinced that you are on the right path in making a biological science out of it.

Sincerely yours,

J. v. Uexküll'

'Ich bin überzeugt, dass Sie viel mehr über die Sprache wissen als ich, was besonders durch Ihre schöne Arbeit über Wilhelm von Humboldt erwiesen wird.

'Mich interessiert die Sprache wesentlich als Verständigungsmittel zwischen Mensch und Tier anschliessend an die Verständigungsmittel der Tiere untereinander. Als Verständigungsmittel dienen den Tieren ausser Bewegungsfolgen auch Lautfolgen, deren Kenntnis den Tieren angeboren ist. Man kann Fasanenküken wohl durch Truthühner, aber nicht durch Haushennen aufziehen lassen, weil die Fasanenküken den Lockruf und den Warnruf der Truthühner verstehen und mit einer entsprechenden Handlung darauf antworten — das Locken und Warnen der Hennen aber garnicht beachten. Es muss die Truthühner-Sprache ein Dialekt der Fasanen-Sprache sein, während die Hühner-Sprache einem ganz anderen Sprachstamm angehört.

'Viele Tiere haben die Fähigkeit, gewisse Laute oder Lautfolgen als sekundäre Merkmale zu verwerten, — so konnte Pawlow zeigen, dass Hunde, die daran gewöhnt worden (waren) vor der Darreichung des Futters ein bestimmtes Klingelzeichen zu hören, bereits auf dieses Lautzeichen allein Speichel zu sezernieren begannen. Pawlow nannte das den "bedingten Reflex". Man kann statt des Klingelzeichens auch das Wort "Fleisch" aussprechen. Trotzdem kann man daraus nicht auf das Verständnis für das Wort Fleisch schliessen.

'Anders liegt es mit Versuchen, die Dr. Sarris im Institut für Umweltforschung ausführte. Ein Hund wurde darauf dressiert, auf das Befehlswort "Stuhl" auf einem bestimmten Stuhl Platz zu nehmen. Dann wurde der Stuhl entfernt und der Befehl wiederholt — darauf nahm der Hund auf allen solchen Gegenständen Platz, auf denen ein Hund sitzen kann. Wir drücken das so aus: bestimmte Gegenstände haben für den Hund einen "Sitzton". (Näheres siehe in "Streifzüge durch die Umwelten von Tieren und Menschen" Uexküll und Kriszat, in *Verständliche Wissenschaften*, Springer, Berlin, und E. G. Sarris, "Die Umwelt des Hundes" in *Die Welt im Fortschritt*, Verlag Herbig, Erste Reihe, Drittes Buch.)

'Das Wort "Stuhl" bedeutet für den Hund nicht einen bestimmten Gegenstand, sondern eine Leistung: Sitzen. Das scheint mir grundlegend zu sein für die Sprache als Verständigungsmittel auch zwischen Menschen. Das gesprochene Wort, also eine bestimmte Lautfolge als Sinn — oder Bedeutungsträger bezieht sich anfangs auf eine bestimmte Leistung, und nicht auf einen bestimmten Gegenstand. Ich bin besonders auf die Fragen, die Sie mir stellten, eingegangen, die mir persönlich näher liegen. Die

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Sprachwissenschaft selbst liegt mir fern — aber ich bin überzeugt, dass Sie auf dem rechten Wege sind, aus ihr eine biologische Wissenschaft zu machen. Mit best. Empfehlungen

Ihr erg. J. v. Uexküll'

10. 'Unser Gemüt besitzt eine innere Planmässigkeit, die sich aber erst dann offenbart, wenn es in Tätigkeit tritt. Daher muss man das Gemüt beobachten, während es, seiner Tätigkeit obliegend, Eindrücke empfängt und verarbeitet' or 'die Gestalt ist niemals etwas anderes als das Erzeugnis eines Planes im indifferenten Stoff, der auch eine andere Gestalt hätte annehmen können.'
11. The question as to whether all rules of language are acquired by learning or whether some are inherited remains unanswered.
12. Sebeok remarks in this connection, 'in other words, the criterial feature of living entities, and of machines, programmed by humans, is semiosis' (personal communication).
13. 'Die Physiologie betrachtet es als Endziel, die biologischen Vorgänge auf physikalische und chemische Probleme zurückzuführen ... Die Grundphänomene der Gewebe, wie die Kontraktion des Muskels, dienen ihr als Ausgangspunkt, von dem man durch Heranziehung elektrischer, resp. osmotischer etc. Vorgänge die Lebensäusserungen auf die Gesetze der anorganischen Welt zurückzuführen sucht. Gerade den umgekehrten Weg beschreitet die Biologie ... Ihre Bausteine sind ... biologische Elemente [aus deren Zusammenarbeiten sie das Leben des Gesamt-organismus zu verstehen sucht.] Deshalb geht sie die Frage nach dem Zusammenhang der belebten und unbelebten Natur nichts an.' Einfügung in Klammern hinzugefügt.
14. 'Die Sinnesempfindung ist nicht die Leitung einer Qualität oder eines Zustandes der äusseren Körper zum Bewusstsein, sondern die Leitung einer Qualität, eines Zustandes eines Sinnesnerven zum Bewusstsein, veranlasst durch eine äussere Ursache, und diese Qualitäten sind in den verschiedenen Sinnesnerven verschieden, die Sinnesenergien.'
15. 'Vor hundert Jahren stellte Johannes Müller die Lehre auf, die sich als blosser Torso bis heute in der Physiologie erhalten hat, dass jede organische Substanz (gemeint ist: lebende Gebilde) sich äusseren Einwirkungen gegenüber grundsätzlich anders verhält als eine im Raum verteilte anorganische Substanz. Ein beliebiger anorganischer Körper, mag er einen zusammenhanglosen Haufen einzelner Teile bilden, oder eine mit einem beziehungsreichen Bauplan ausgezeichnete Maschine sein, verhält sich der Aussenwelt gegenüber durchaus anders als ein jeder Organismus oder jedes Organ, das aus lebenden Zellen besteht, weil jede lebende Zelle ein Autonom und kein Heteronom ist.
'Wenn eine Maschine, sagen wir ein Auto, äusseren Einwirkungen chemischer oder physikalischer Art ausgesetzt wird, so antwortet es nur in dem einen Fall, wenn ein Hebel bewegt wird, als ein Ganzes und fährt davon. In allen anderen Fällen antwortet es, als wenn es ein Haufen von Erzen wäre, dessen Teile sich verschieben, wenn er gestossen wird, die warm werden, wenn man sie erhitzt, oder die rosten, wenn man sie mit Säure begiesst. Ganz anders benimmt sich, worauf Müller hinwies, ein Muskel. Einen jeden beliebigen äusseren Anstoss mechanischer, elektrischer oder chemischer Art beantwortet er nie wie ein Haufen einzelner Teile, sondern immer als ein Ganzes — als Muskel — mit einer Verkürzung. Dies nannte Müller seine spezifische Energie. Das Wort Energie bedeutete damals so viel wie Lebensenergie, d.h. einen immateriellen Faktor und hat nichts mit physikalischer Energie zu tun. Die spezifische Energie unterliegt auch keineswegs dem viel später aufgefundenen Gesetz der Erhaltung der Energie. Man könnte auch "Ganzheitsenergie" sagen, die niemals übertragen werden kann.'
16. Sebeok's commentary on this point: 'This is the doctrine "aliquid stat pro aliquo", or what Jakobson recently dubbed "renvoi"' (personal communication).

17. '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 price of its destruction.
18. Leach considers music to be an even better paradigm than language, because in the case of music, metaphor (paradigmatic association, harmony) and metonymy (syntagmatic chain, melody) are continually active together. He says: 'The prototype of a general message-bearing system is not a line of type but the performance of an orchestra where harmony and melody work in combination' (Leach 1976: 25). His quotation of Lévi-Strauss sounds like an illustration of Jakob von Uexküll's 'plan': '... "the myth and the musical work are like conductors of an orchestra, whose audience becomes the silent performers" ...' (Leach 1976: 43).
19. 'Eine lebende Zelle besitzt ihren eigenen Ichtton.'
20. 'Dem Forschungsdrang des naiven Beobachters, die körperlichen Gestalten, die ihn umgeben, zu prüfen und ihre Wirkungen aufeinander zu studieren, ruft Kant ein kategorisches "Halt" zu. Erst untersuche, was Du selbst als Subjekt in die Natur hineinträgst, ehe Du das Wesen der Dinge, die Dich umgeben, zu erforschen unternimmst. Erst prüfe Deine eigene Anschauung, ehe Du ein Urteil über die von Dir angeschauten Dinge abgibst! Und nun belehrt ihn Kant, dass Raum und Zeit keine Objekte sind, die man aus der Menge anderer Objekte herausnehmen und für sich betrachten und betasten kann, sondern dass sie die Formen unserer Anschauung sind. Sobald wir uns der Naturbetrachtung zuwenden, tragen wir notgedrungen Raum und Zeit als die elastischen Rahmen mit hinzu, welche die jeweils vorhandene Menge der Erscheinungen vollständig umfassen und in die wir alle Dinge, grosse und kleine, ferne und nahe, vergangene und zukünftige, einordnen.
'Die Eigenschaften aller Dinge, so belehrt uns Kant weiter, gehören nicht ihnen an, sondern sind lediglich von uns hinausverlegte Sinnesempfindungen. Gerade soweit der Schatz unserer Empfindungen reicht, so weit reicht auch der Schatz der Eigenschaften aller Dinge.'
21. '... "Alle Wirklichkeit ist subjektive Erscheinung." Dies muss die grosse grundlegende Erkenntnis auch der Biologie bilden ... Mit dieser Erkenntnis betreten wir alten, gesicherten Boden, der durch Kant in einzigartiger Weise vorbereitet ist, um das Gebäude aller Naturwissenschaft zu tragen. Kant hat das Subjekt Mensch den Gegenständen gegenüber gestellt und die Grundprinzipien aufgefunden, nach denen von unserem Gemüt die Gegenstände aufgebaut werden.
'Die Aufgabe der Biologie besteht darin, die Ergebnisse der Forschungen Kant's nach zwei Richtungen zu erweitern: 1. Die Rolle unseres Körpers, besonders unserer Sinnesorgane und unseres Zentralnervensystems, zu berücksichtigen und 2. die Beziehungen anderer Subjekte (der Tiere) zu den Gegenständen zu erforschen.'
22. 'Das weist darauf hin, dass alle Merkzeichen, gleichgültig um welche Qualität es sich handelt, immer die Form eines Befehls oder Impulses haben ... Wenn ich behaupte, der Himmel sei blau, so tue ich das, weil die von mir hinausverlegten Merkzeichen der fernsten Ebene den Befehl geben: Sei blau! ... Die Empfindungen des Gemüts werden beim Aufbau der Welt zu Eigenschaften der Dinge, oder, wie man sich auch ausdrücken kann, die subjektiven Qualitäten bauen die objektive Welt auf. Setzt man an die Stelle von Empfindung oder subjektiver Qualität das Merkzeichen, so kann man sagen, die Merkzeichen unserer Aufmerksamkeit werden zu Merkmalen der Welt.'
23. 'Jede farbige Fläche unseres Schraums, welcher Art sie auch sein möge, bildet ein Hindernis, das nah — oder fern gelegen ist. Alle rufen die gleiche Empfindung wach, nämlich die eines Hemmnisses, gleich den Widerständen, die sich der tastenden Hand

24 *Thure von Uexküll*

darbieten. Dadurch erhalten sie den Charakter des Stofflichen, der, allgemein gefasst, nichts anderes als ein reales Hindernis bedeutet. So kommt es, dass wir alle Dinge, die als Hindernisse ihre Wirklichkeit beweisen, als Stoffe bezeichnen.'

24. 'Kraft ist ursprünglich nichts anderes als eine Empfindung, die mit der Bewegung unserer Muskeln verbunden ist. Durch einen unkontrollierten Schluss wird die Muskelempfindung zur Ursache der Bewegung unserer Glieder erhoben und dann zur Ursache aller Bewegungen überhaupt verwandelt ... Durch die Zurückführung der materiellen Vorgänge im Raum auf die Lokalzeichen und Richtungszeichen ist die subjektive Natur auch dieser Phänomene zweifelsfrei erwiesen und damit die Stellung der sogenannten objektiven Naturwissenschaften innerhalb der Biologie klar gekennzeichnet.'
25. 'Unser ganzes Gedächtnis ist wie der Schnürboden eines Theaters mit Kulissen, mit Schematen ausgefüllt, die gelegentlich auf der Bühne des Bewusstseins erscheinen ...'
26. 'Leider ist uns der Blick auf eine fremde Bewusstseinsbühne verwehrt — nichts könnte belehrender sein, als die Welt durch fremde Schemata anzuschauen. Aber eines sollten wir nie vergessen: Wenn wir unsere Nebenmenschen um uns umherwandeln sehen, so schreiten sie auf unserer Bühne umher, während wir uns auf ihrer Bühne bewegen. Diese Bühnen sind niemals identisch, in den meisten Fällen sogar grundverschieden. Und wir können nicht verlangen, auf der Bühne der andern die gleiche Rolle zu spielen, wie auf der eigenen.'