Jacob von Uexküll: a vitalist?

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JACOB VON UEXKÜLL: A VITALIST?

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ABSTRACT

What is Life? What are its properties and how do they originate? Answering these questions is at the very core of the field of biology. Throughout history, the possible answers have fallen within a spectrum bounded by two opposing alternatives: Are the properties of life reducible to matter and physico-chemical forces? Or are they manifestations of some agent like a soul that is imprinted into matter? At the start of the 20th century, the scientist and later philosopher, Hans Driesch famously argued in favour of the latter: according to him, there is an extra-material agent that organizes matter. He called this factor Entelechy. An organism is no longer just a combination of material elements, but a new category. At the same time, a friend of Driesch's also opposed the materialistic claim, but argued that there is no such thing as an extra-material active agent behind the properties of life. Instead there is a plan. This researcher was Jacob von Uexküll. In his opinion, the properties of life are explained by an all-encompassing conformity with a plan in nature.

Driesch's views are unanimously labelled as vitalistic, while, on the other end of the spectrum we have mechanicism – life is reducible to matter and forces. Can von Uexküll be branded a vitalist like Driesch? The opinions differ. Von Uexküll did not consider himself to be one. Instead he favoured an intermediate position, between the two ends of the spectrum. But some authors have argued otherwise.

The following investigation hopes to shed some light on this question. The journey will take us first on a recapitulation of the great debate over the properties of life. Here we will define what we mean by vitalism and its opposite, mechanicism. Then the views of both Hans Driesch and Jacob von Uexküll will be presented, and later compared in more detail. We hope to tackle several questions raised by von Uexküll's views: What does he mean by conformity with a plan? What exactly is this plan? Where does it come from? Can we know it? How does it direct organisms? These questions will then be compared with Driesch's biological theory. At the end we hope to present a clearer view of von Uexküll and his intriguing ideas.

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Part 1

Chapter 1 – Introduction

According to Martin Heidegger, the science of biology has risen from two decisive steps. The first was provided by the experiments and conclusions of Hans Driesch (1867-1941), who highlighted the holistic character of the organism and its wholeness. The second decisive step was provided by Jacob von Uexküll (1864-1944): it "is the insight into the essential significance of research concerned with how the animal is bound to its environment" (Heidegger 1995, p. 261). As Jacob von Uexküll states: "All reality is subjective appearance. This must constitute the great, fundamental admission even of biology. It is utterly vain to go seeking through the world for causes that are independent of the subject; we always come up against objects, which owe their construction to the subject"[1] (von Uexküll 1928, p.2, his emphasis).

How did we get here? Von Uexküll's statement and, as we shall see, Driesch's discoveries, are especially interesting when we notice how they pertain to one of the oldest debates in biology: the discussion over the properties of life. Should one defend mechanism, where life is reducible to its physico-chemical components and laws? Or vitalism, where one needs to invoke an extra-material agent to explain life's specific properties?

Hans Driesch was one of the most ardent defenders of the latter position in the 19th and 20th centuries, and his conclusions resulted from his extensive embryological experiments: "For these experiments seemed to confirm the old conception of life, according to which the organism behaves in a purposive manner, and suggested that we must try and explain this purposiveness. Thus Driesch was driven by his experiments to adopt his biological theory, known as neovitalism, which is characterized by the appeal to a certain force or entelechy." (Heidegger 1995, p. 262).

Yet, whenever von Uexküll is mentioned there is still no definite consensus concerning his contribution to this discussion. Some have argued for his association with the neo-vitalistic ideas of Driesch: "In many dictionaries of philosophy the Umwelt theory is described as neo-vitalism, and thereby labelled as some kind of a romantic philosophy of nature." (Krampen

[1] Alle Wirklichkeit ist subjektive Erscheinung — dies muß die große grundlegende Erkenntnis auch der Biologie bilden. Ganz umsonst wird man die gesamte Welt durdhstöbern nach Ursachen, die unabhängig vom Subjekt sind, immer wird man auf Gegenstände stoßen, die ihren Aufbau dem Subjekt verdanken.

1987, p. 148). And some of von Uexküll's statements appear to support the same verdict: "The description of the forms was followed by research into the processes in living beings, and the bases of chemistry, physics and mechanics were completely sufficient for this. So it came about that one learned to regard living beings as physico-chemical machines. The justification of this view has of course been denied more than once by those researchers who examined the connection between objective processes and subjective phenomena. In the process, one came across life factors that could by no means be subordinated to the laws of physics and chemistry."[2] (von Uexküll 1928, p.1).

However, other authors, including von Uexküll's own son, have argued against this association: "in interviews that took place in Freiburg, Germany, in 1989, [Jacob von] Uexküll's son, the psychosomaticist Thure von Uexküll, repeatedly denied that his father was a vitalist and was highly critical of the historical judgment that would set his father in the same camp as such self-proclaimed neo-vitalists as Hans Driesch. Rightly or wrongly, contemporary judgments and habits of thought were clearly different—the two men were frequently paired, by critics and supporters alike, as Germany's two leading twentieth-century defenders of vitalism in biology." (Harrington 1996, p. 52).

Faced with this conundrum, we are left with the question: was this "historical judgment" fair to the ideas of von Uexküll? If we take a deeper look at the ideas of Jacob von Uexküll what will we find? Will it turn out that we have evidence to place von Uexküll alongside his friend and contemporary Hans Driesch? Or will we find out that von Uexkull's ideas do not match with Driesch's?

In order to contextualize Jacob von Uexküll's specific position we need to first understand the historical background preceding von Uexküll's work, specifically the mechanism-vitalism debate, and his connection to Hans Driesch.

[2] Auf die Beschreibung der Formen folgte die Erforschung der Prozesse in den Lebewesen, und dafür reichten die Grundlagen der Chemie, Physik und Mechanik vollständig aus. So kam es, daß man die Lebewesen als physikalisch-chemische Maschinen zu betrachten lernte. Die Berechtigung dieser Auffassung ist freilich von jenen Forschern, die den Zusammenhang der objektiven Prozesse mit den subjektiven Phänomenen untersuchten, mehr als einmal in Abrede gestellt worden. War man doch dabei auf Lebensfaktoren gestoßen, die sich keineswegs den physikalisch-chemischen Gesetzen unterordnen ließen.

1.A – Mechanism and Vitalism

As we have just mentioned, the ideas of Hans Driesch and von Uexküll fit into the great discussion between the mechanistic and vitalistic understandings of life. The debate is one of the oldest and most central debates in the philosophy of biology. Crucially, the contended issue does not concern the existence of such a thing as a living being, with a higher level of organization, with a certain behaviour. On these matters both parts of the debate agree. The focal point of the discussion is on the properties of life and, in particular, on the source of such characteristics: "Their disagreement [mechanists and vitalists] is not fundamentally over matters of description, but has to do with the accounting for that description. They disagree on why living things are as they are"; "(…) there is a core of agreement between vitalists and mechanists on what is to be explained." (Hein 1972, p. 161-162).

We will see how, throughout history, the pendulum shifted from one side of the debate to the other, especially, as we will focus here on the 17th century onwards: "Between the seventeenth and nineteenth centuries, theoretical biology witnesses the alternating hegemony of mechanists and vitalists, without either of the two currents prevailing permanently. The context is very heterogeneous because the debate between the two theoretical macrosystems occurs in the concrete setting of the interpretation of single scientific discoveries, and therefore depends on a large number of contingent factors (new investigative tools, new knowledge in the fields in question, etc.). There are also many in-between positions, which combine elements of mechanism and vitalism in original syntheses, often directed at providing an ad hoc theoretical background for the work of individual scholars." (Brentari 2015, p. 50). This means that, before we move on to the history of this debate, we need to at least introduce each of the opposing stances of the discussion: mechanism and vitalism.

When we talk of mechanism, it means more specifically "just one of several forms of a broader philosophy of materialism" (Allen 2018, p. 59). Materialism, in a general sense, affirms that all natural phenomena are physical: "Materialism is the view that all phenomena in the universe depend upon the interactions of some sort of material particles (derived from Greek 'atomism') in continuous motion, whose collisions generate events/phenomena in the world." (Allen 2018, p. 59). In other words, it is an ontological claim: "the entire physical universe operates solely according to the interactions of matter and energy. No 'vital forces' exist, and all living phenomena consist only of chemical and physical processes. (Gilbert and Sarkar 2000, p. 1).

The mechanistic claim adds that "nature can best be understood as a mosaic of separate parts, a detailed description of which, when combined together, yields a complete description/understanding of the phenomena in question." (Allen 2018, p. 60-61).

Besides the materialistic ontological claim, there is also a more pervasive reductionist epistemological stance: mechanism sees nature as analogous to machines and machine-like processes (Allen 2018 p. 59). Thus, "all complex entities (including proteins, cells, organisms, ecosystems) can be completely explained by the properties of their component parts." (Gilbert and Sarkar 2000, p. 1). Its strategy is "to investigate higher-level processes by reducing them to their lower levels of organization: for example, cells in terms of molecules, organs in terms of cells, organisms in terms of organ-systems, and the like." (Allen 2018, p. 61)

In the vitalistic view we observe a different perspective of the characteristics of life, as expected. It is opposed to the two claims presented by mechanicism. First of all, it is opposed to the epistemological reductionist claim. Vitalism considers that in organisms there is a higher level of organization, irreducible to its components. Additionally, and more specifically, vitalism is also opposed to the ontological materialistic claim. There has to be an organizing principle or agent. According to Hein: vitalism "denies the principle of self-assembly of matter, and affirms that not only is it necessary to explain the fact of organization, but also that there must be an explication [sic] of each level of organization in terms of its place within the hierarchy. In other words, it is not sufficient to describe the constituent parts and their formal relations among themselves. Over and above any such pattern of organization is a principle which organizes the parts in terms of the whole of which they are a part. This marks the difference between an aggregate, which is merely a summation of discrete entities, and an organism, which is a whole whose complex parts are determined by their position within that whole." (Hein 1972, p. 180-181).

Crucially, vitalism goes all the way to affirm that this higher level of organization is provided by a "vital component", that is, one that goes beyond matter and physico-chemical forces. According to Gilbert and Sarkar: "living matter is ontologically greater than the sum of its parts because of some life force ('entelechy', 'elan vital', 'vis essentialis', etc.) which is added to or infused into the chemical parts." (Gilbert and Sarkar 2000, p. 1). Or in Allen's words: "(…) many of these alternative views were mostly couched in mystical terms, as the result of some immaterial, 'vital,' or 'directive' force ('vitalism') that had no counterpart in the non-living world. Many vitalistic theories were considered to be serious alternatives to standard

mechanistic explanations in that they posited law-like activities, but just not the sort that arose from ordinary physical or chemical processes." (Allen 2018, p. 60)

1.A.1 – Causality

A crucial topic in the context of the mechanism vs vitalism debate concerns the nature of causality: "The question of how, through what means and energies, the individual organism actually is produced out of the egg. We have here to do, as we see, with a problem in embryology, but not simply in a descriptive and comparative sense, but in a causal sense" (Driesch 1951, p.67; quoted in Harrington 1996, p. 48). Here we also find a disagreement between the opposing views: "mechanists and vitalists also disagree greatly on what type of causal links should be allowed in biology." (Brentari 2015, p. 48).

Here we will only produce a brief sketch of this issue. The question of causality is a vast and complex one. Additionally, it is not the main focus of this investigation. Therefore, we will only go through the most relevant aspects of this topic, especially as concerns the context of this work.

Historically, the understanding of causality in biology might be retraced to Aristotle's theory of causation, identifying four types of causes, which the Aristotelian tradition translated as: "the causa materialis (or stuff), the causa formalis (or shape), the causa efficiens (or force) and the causa finalis (or goal)." (Mahner and Bunge 1997, p 36). By Aristotle's time, we already find the first instances of the debate unfolding: "the view that there are in nature causes besides material and efficient causes was controversial in antiquity. According to Aristotle, most of his predecessors recognized only the material and the efficient cause. This explains why Aristotle cannot be content with saying that formal and final causes often coincide, but he also has to defend his thesis against an opponent who denies that final causality is a genuine mode of causality." (Falcon 2019).

How do mechanists and vitalists relate to Aristotle's theory of causation? On the mechanistic side of the debate, we find the rejection of any kind of final cause. The phenomena should only be explained through material and efficient causes, in what can be generally called mechanical causality: "The mechanists, for their part, totally reject the existence of final causes in favour of mechanical or antecedent causes; that is of easily identifiable events that are the origin of the changes of matter and energy that we are called upon to explain" (Brentari 2015,

p. 49). On the vitalistic side, the phenomena of life cannot be fully grasped without the consideration of final causality: "vitalists deem as final those causes essential to a proper understanding of living organisms. (…) It therefore becomes almost inevitable to turn to the influence of an extra-material and extra-temporal entity, precisely entelechy, which affects matter as the 'representative' of the future state of the organism." (Brentari 2015, p, 48)

What about Driesch and von Uexküll? It is useful to briefly introduce their view concerning causality and take a brief look at their vocabulary. Driesch uses the terms "singular" or "additive" causality when referring to mechanical causality: "This is the type of becoming that is illustrated by the sciences of the inorganic world." (Driesch 1914, p. 199). As we will see, he defends that this type of causality is not sufficient to explain the phenomena of life: "All proofs of Vitalism, i.e. all reasonings by which it is shown that not even machine-theory covers the field of biological phenomena, can only be indirect proofs: they can only make it clear that mechanical or singular causality is not sufficient for an explanation of what happens." (Driesch 1914, p. 208). "(…) there are more possible forms of causality than only spatial or singular i.e physico-chemical or mechanical causality" (Driesch 1914, p. 207). Instead, Driesch says that another type of causality should be considered, one that he calls "unifying" or "individualizing" causality: "in which a distribution of the things in one system of the form of a mere sum would be transformed into a distribution that would be in some sense a unity or totality, without any spatial mechanical predetermination of this totality" (Driesch 1914 p. 200). In other words, "a sum (of possibilities of happening) is transformed into a unity (of real results of happening) without any spatial or material preformation of this unity." (Driesch 1914 p. 215).

Von Uexküll will also affirm that mechanical causality is not sufficient. Yet, it is important to notice that von Uexküll uses the terms in a different way. In his works, "causality" only includes the mechanical type, and does not have to do with final causes. It is in this context that we understand his anti-reductionist critiques: "There is only dead matter and forces! This is a statement that a biologist who has studied the development of animals cannot accept" (von Uexküll 1913, p. 253). He adds: "No wonder that physics tries to explain all connections in the world exclusively through causality and rejects any other way of looking at things. And yet it

is wrong, because causality is not the only rule we have to order the world."[3] (von Uexküll 1928, p. 81).

The understanding of finality requires the introduction of a new category – conformity with plan (*Planmässigkeit*): "One thing will have become clear from the treatment of the problem so far: biology has to deal only with the conformity with plan and the study of causality can only be considered in so far as it contributes to the study of the conformity with plan"[4] (von Uexküll 1928, p. 102). We can thus get a glimpse of von Uexküll's ideas: "Uexküll believes that embryonic development, growth and (in organisms with this capability) the regeneration of body parts are processes that do not only react to given conditions – according to the physiological schema of antecedent causality, which is typical of reflexes – but they themselves establish little by little the conditions for achieving an ultimate end (and thus clearly fall under the biological category of final causality)." (Brentari 2015, p. 61)

1.A.2 – Origins of the Mechanism vs Vitalism Debate

As pointed out above, the debate over the properties of life is one of the oldest discussions in the life sciences and the philosophy of biology. As also mentioned before, throughout the history of the debate, the reigning perspective has shifted: "These mechanist-vitalist debates punctuated the history of biology, producing a pendulum swing at times away from Mechanism, at times back toward it," (Allen 2008, p. 60). Yet, as we will see, both perspectives underwent transformations throughout history: "Neither mechanism nor vitalism has remained static in its conceptualization of the nature of life. Although their basic distinctions as characterized above have remained fairly constant, their actual positions have altered with the general evolution of science." (Hein 1972, p. 165).

The mechanism/vitalism debate has found a major battleground in the area of embryonic development. The main discussion took place between preformationism (according to which all the parts of the embryo are present in miniature inside its germ) and epigeneticism

[3] Kein Wunder, daß die Physik es versucht, alle Zusammenhänge in der Welt ausschließlich durch die Kausalität zu erklären und jede andere Betrachtungsweise ablehnt. Und doch hat sie unrecht, denn die Kausalität ist nicht die einzige Regel, die uns zur Verfügung steht, um die Welt zu ordnen.

[4] Eines wird aus der bisherigen Behandlung des Problems klar geworden sein, daß die Biologie sich nur um die Planmäßigkeit zu kümmernhat und die Erforschung der Kausalität nur insofern in Frage kommt, als sie zur Erforschung der Planmäßigkeit mit beiträgt.

(according to which each part is created anew during the development): “Preformationists claimed that all features of an adult individual already exist in the germ cells—often illustrated with the picture of a mini-man inhabiting the ovum or the sperm—and, therefore, that development mainly means growth. In contrast, those who referred to embryological development as epigenesis (e.g. Galen, William Harvey) argued that central morphological structures of the later organism newly evolve during the embryo’s growth process.” (Lux 2017, p. 50). The debate is significant in the area of development due to the association between the two main developmental theories and the two positions at stake in the debate we are addressing: “The connection between epigenesis and vitalism on the one hand, and preformation and mechanism on the other, is obvious.” (Klerk 1979, p.7).

How does embryology relate to the mechanism/vitalism debate? According to Brentari, there is some overlap between the opposing sides in each discussion: “Now, despite being unable to establish a clear correspondence between preformism and mechanism (or between epigenesis and vitalism), we can however affirm that the preformist theories are prevalently mechanistic” (Brentari 2015, p. 124). In other words: “Preformationism was compatible with the prevailing mechanistic world view, which also precluded the emergence of qualitative novelty by assuming that every change can be reduced to mechanical causes and effects” (Mahner and Bunge 1997, p. 278). In the case of epigeneticism, the absence of any kind of structure raises an issue: “If the egg is really unstructured or homogeneous, what accounts for the continuity and specificity of development, and where does the increasing complexity in the development of organisms come from? To answer this question, the epigeneticists had to postulate some unobserved force able to direct and guide development. Thus, epigeneticism invites vitalism.” (Mahner and Bunge 1997, p. 279). Indeed, as Driesch stresses: “All believers in epigenesis are Vitalists, and it is just for this reason that the whole controversy is of such great importance to us.” (Driesch 1914, p. 39)

1.A.3 – *Scala Naturae*

So far we have noted how the main battleground of this discussion is in the field of embryology. As an organism develops, it progresses from what is apparently the simplest form (the initial cell) to the more complex one (the fully formed organism). Yet, it is not only in ontogenetic development that we find a similar progression. For it also takes place in the phylogeny of organisms. As we will later see claimed by Jacob von Uexküll, whenever we look at the

phylogenetic distribution of living beings, we find an increase in the complexity of life forms. He refers to this issue when dealing with the meaning of "development": "Development (*Entwicklung*) or unfolding (*Entfaltung*) means that the formation of folds decreases. Now, however, the increase in diversity observed in the realm of the living, beginning with the very simple amoeba up to the mammals, should be expressed by development. It is obvious that this is a complication; for no one will deny that the relations of the parts to one another and to the whole are much more intricate in mammals than in amoebas. So how can one speak of a development when one has in mind the transition from a simple to a complex organism?"[5] (von Uexküll 1928, p. 196-7).

This categorical ranking, from simpler to more complex organisms, is defined as the *scala naturae* and can be detected both in phylogeny and ontogenetic development. This consequently expands the field of the discussion over mechanism and vitalism.

We can look at the *scala naturae* in this strict sense: a ranking system used to organize all different life forms, as Arthur Lovejoy describes in his book "*The Great Chain of Being*": "The result was the conception of the plan and structure of the world which, through the Middle Ages and down to the late eighteenth century, many philosophers, most men of science, and, indeed, most educated men, were to accept without question – the conception of the universe as a 'Great Chain of Being,' composed of an immense, or – by the strict but seldom rigorously applied logic of the principle of continuity – of an infinite number of links ranging in hierarchical order from the meagerest kind of existents, which barely escape nonexistence, through 'every possible' grade up to the *ens perfectissimum* – or, in a somewhat more orthodox version, to the highest possible kind of creature, between which and the Absolute Being the disparity was assumed to be infinite – every one of them differing from that immediately above and that immediately below it by the 'least possible' degree of difference." (Lovejoy 1936, p. 59). Lovejoy describes how this system appears in different forms, consciously or not, a part that would be eventually played by the concept of "Evolution": "Next to the word 'Nature,' 'the Great Chain of Being' was the sacred phrase of the eighteenth century, playing a part

[5] Entwicklung oder Entfaltung will doch besagen, daß die Faltenbildung abnimmt. Nun soll aber mit Entwicklung die im Reiche des Lebendigen beobachtete Steigerung der Mannigfaltigkeit, beginnend von dem [*sic*] ganz einfachen Amöben bis zu den Säugetieren, ausgedrückt sein. Daß es sich hierbei um eine Verwicklung handelt, ist augenscheinlich; denn niemand wird leugnen, daß die Beziehungen der Teile unter sich und zum Ganzen bei den Säugetieren viel verwickelter sind als bei den Amöben. Wie kann man daher, wenn man den Übergang vom einfachen zum verwickelten Organismus im Auge hat, von einer Entwicklung sprechen ?

somewhat analogous to that of the blessed word ‘evolution' in the late nineteenth.” (Lovejoy 1936, p. 184).

What does this categorical system involve? The totality that is focused on by Lovejoy (the *scala* as the internal structure of the web of life) is not an absolute concept. It is at least implicitly, if not explicitly, inscribed in a vaster framework. This framework also has the shape of a *scala*, which corresponds to a *scala naturae* in a “broader” sense. In this sense we refer to Lovejoy’s formulation as a “narrower” conception of the *scala*. The broader one encompasses the narrower one.

Yet, it should be noted that we cannot study all of the elements in the complex of the *scala naturae*. That is also not the point of this work. But we cannot avoid going through some of its features. They are crucial for understanding the idea of *scala* itself. Here we are especially concerned with the analysis of both the differences and the connections between the *scala* in the narrower and broader senses.

1.A.3.1 – Aristotle and Charles de Bovelles

Firstly, it is important to consider what the very idea of “*scala*” is all about. A scale always concerns the transition from the *less* to the *more*. It has a hierarchical structure. On the one hand, a hierarchical structure can be shaped in such a way that each upper level is completely heterogenous from the previous one so that we do not find the latter in the former i.e. the “1” within the “2”. Yet, this is not the case with the *scala naturae*.

In Book 2 of *De Anima* (414b28), Aristotle refers to the fact that every rectangle (and for that matter, every for four sided polygon) is a triangle to which something new has been added; in other words, a rectangle is a transformed triangle. On the one hand, this addition makes the triangle disappear, dissolving it, as it were, into the new figure (as Aristotle says, we can only find it potentially), but in such a way that, on the other hand, the new figure is possible only as the transformed version of the first one. Furthermore, this transformation can be iterated, so that it continues from one level to the next: “2” works as the rectangle in relation to “1”, “3” in relation to “2” and so on. A later stage results from the cumulative transformation of all the previous ones. This is the basic structure of this scale. This is what Aristotle terms an “ephexês”

connection and it is the basic structure of what the "scala" is all about. We find a scale every time that there is a multiplicity articulated in this way, a relationship of this order.[6]

One area where we can apply the "ephexês" connection is precisely in the background where we are already implicitly or explicitly placing the *scala naturae* in the narrower sense (as described by Lovejoy): as a representation of the internal structure of the web of life. But we should note that, as we have mentioned before, the web of life itself is already placed inside a vaster scale. What scale is this? It is this one: the scale of *esse, vivere, percipere, intelligere*.

We should clarify that we are not just talking about two separate depictions of the scala naturae, one narrower and the other broader – both forms are part of the same complex, they are not dissociable. The *scala naturae* in the narrower sense always presupposes the *scala naturae* in the broader sense, namely with the latter framing the former. In other words, the *scala naturae* in the narrower sense always appears in the context of the broader one.

The sketching of the broader scala naturae goes back to Antiquity (with both Plato and Aristotle). It played an important role in Stoic thought and passed on to the Fathers of the Church. Here we will not consider all its historical developments. We will instead refer to a later version, which has the advantage of being very clear, concise and incisive, and accessible: the one found in the work by the 16th century mathematician and philosopher Charles de Bovelles (or Carolus Bovillus), namely in his "*Liber de sapiente*".

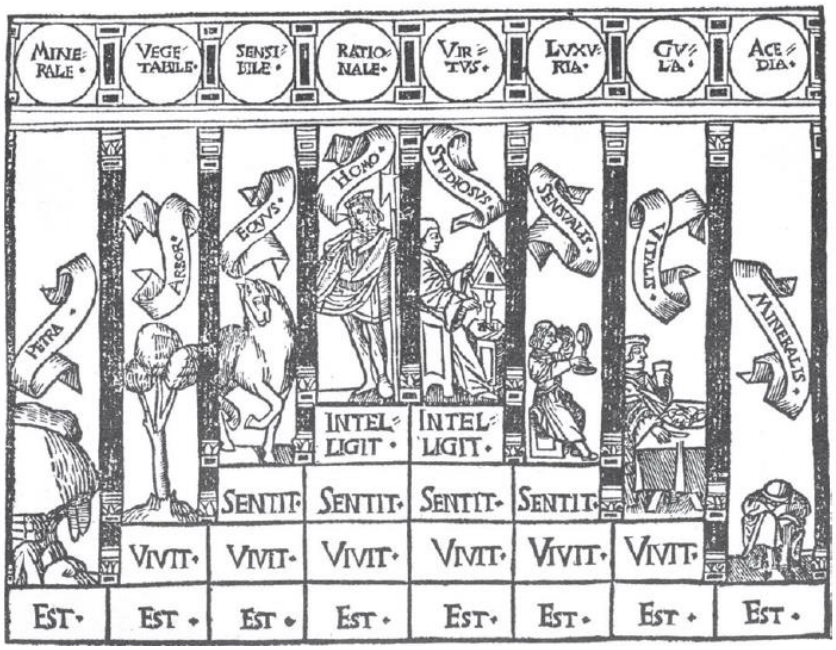
Here we find the four levels of being, in increasing levels of complexity: *esse* (being), *vivere* (living), *percipere* (feeling) and *intelligere* (thinking), or, as C. de Bovelles puts it, *essentia, vita, sensatio, ratio* (*subsistentia, viventia, sensibilia, rationalia*) and we should note that they are connected by what we have termed an "ephexês" structure. Each subsequent level includes all the characteristics of the previous one and some new determinants. Thus, *esse* is possible without *vivere*, but not the opposite; *vivere* is possible without *percipere*, but not the opposite, and so on and so forth. And what is more, *vivere* is nothing but a transformed arrangement of esse, *percipere* is nothing but a transformed form of *vivere* etc. Therefore, *esse*

[6] Aristotle refers to this ephexês structure in the context of his discussion of the connection between the two main components of living beings, namely a) the nutritive faculty (what might be termed the vegetative component) and b) the perceptive faculty (what might be termed the more-than-vegetative component). But two things should be born in mind. First that the ephexês connection Aristotle is talking about, namely, between the vegetative and the perceptive stages of life, has relevance both for ontogeny and phylogeny. Secondly, that it can also be applied to other fields, so that it ultimately stands for a formal and general model.

is the basic level of the *scala*. It is subsumed in everything and the *fons et origo* from which everything depends. It corresponds to Aristotle's triangle, meaning that *vivere* acts as quadrilateral in relation to *esse*, and *percipere* is a quadrilateral to *vivere* etc.

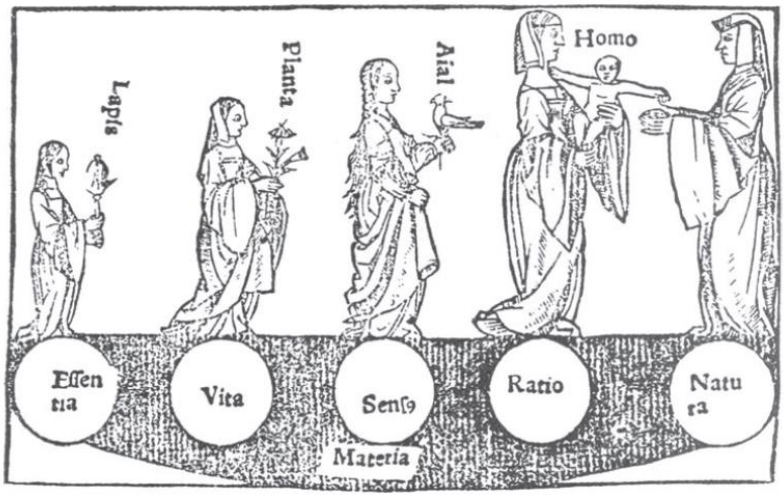
Here are two of the pictures used by C. de Bovelles to illustrate the idea of *scala naturae* in the broader sense. It should be noted that Figure 1 is intended to illustrate both a) the *scala naturae* and b) C. de Bovelles' version of the traditional view according to which one's way of life can reduce one to something similar to mere "sentire", to mere "vivere" or even to mere "esse".

Figure 1



(adapted from Cassirer 1927, p. 306)

Figure 2



(adapted from Cassirer 1927, p. 315)

How is each level characterized? According to C. de Bovelles, the first level (*esse*) contains everything that exists and, exclusively in this stage, inorganic matter: "the things that exist and that is all, like the minerals, are in their very nature immobile, amorphous, disharmonious, undifferentiated, and at the same time, occult, hidden, buried in the earth, like in the uterus of the mother common to all"[7] (Cassirer 1927, p. 307). On the second level (*vivere*), the properties of life are introduced: "The things that are alive, participate in the vital motion of the waters and move spontaneously, feed themselves, grow, reproduce themselves."[8] (Cassirer 1927, p. 307). Here, encompassing the two lower levels we find vegetable life e.g. plants and fungi. Yet the latter are not included in the following level, which introduces the ability to feel (*percipere*). Here we find the different types of animal life: "To the beasts and to the beings supplied with sensibility appertains first of all the free ability to transfer from one place to another; with it they avoid harmful things and approach that which is useful, comfortable and necessary, be it food or place."[9] (Cassirer 1927, p. 307). In the end, we reach the highest level of complexity, namely, thinking (*intelligere*), which is the distinctive feature of human life: "Only to men has

[7] Nempe ea, que solum sunt, ut mineralia: suapte natura immota sunt, informia, incomposita, sine differentia, iugiter in terra – ut in comunis omnium matris utero – oculta, abdita, sepulta.
[8] Que vivunt: vitali aquarum motu participant primaque se movent, aluntur, augentur, propagantur.
[9] Bestiis porro et iis, que sentiunt: libera et precipua adest se de loco in locum transferendi facultas; qua et quod contrarium est, vitant et quod utile, commodum ac necessarium, sive sedem sive alimoniam perquirunt.

standing, having an erect posture and looking at the celestial things been granted by nature."[10] (Cassirer 1927, p. 307).

Ultimately, C. de Bovelles' perspective of the *scala naturae* in the broader sense can be summarized in the following lines: "*Finge etenim Naturam, cunctorum matrem, quattuor filias ex utero peperisse: primam Substantiam, secundam Vitam, tertiam Sensum, quartam Rationem, cunctarum filiarum speciosissimam, sapientissimam, matri Nature parem et equalem, cuius moderamini ceteras filias tanquam imperfectas ac sui incompotes Natura subdiderit.*" (Cassirer 1927, p. 311).

1.A.3.2 – A Natural Ontology

At the end of the day, we have been describing some decisive features of the *scala naturae* in the broader sense. What do these observations ultimately mean for our understanding of the natural world?

Firstly, this sequence works as if it were the categorical scale that is the common denominator between the pre-scientific, the scientific and philosophic points of view. It is a common denominator because spontaneously, whether we are aware of it or not, it is all encompassing, and all elements of the world are located within its fundamental framework. It is characterized by corresponding to a totality to which there is no exterior.

Additionally, this overarching *scala naturae* seems to apply not only to those realities that we know of, without exception, but it also seems to be forcefully applied to all kinds of realities – all realities that exist, no matter how unknown they may be. That is, the *scala* corresponds to an outline of the basic structure of existence that all reality has to conform to. It can therefore be described as a *natural ontology*: everything is immersed in it, and it claims to be of universal validity. It does not allow for any alternatives.

Finally, the *scala naturae* also claims to be absolutely self-evident and intelligible. This applies both to its categories, that is, what is meant by *esse*, *vivere*, *percipere*, etc., and also as regards the connection between these stages, their nexus.

[10] Solis Hominibus erigi, sublimi esse statura et celestia spectare a Natura est datum et concessum.

The *scala* in the broader sense rules automatically, unconsciously – it is valid even if we do not pay attention to it. However, this occurs in such a way that it still allows for the subsistence of difficulties that can be detected in a more detailed examination.

Such an analysis can take place in both the philosophic and scientific fields. In fact, the philosophic and the scientific discourses both arise from the evaluation of the basic structure of the scala naturae, whether this evaluation is of a more extended or limited nature. Furthermore, a big part of this analysis concerns the discontinuities, the breaks between the different levels. Thus, where exactly in the spectrum of life-forms do these moments of discontinuity happen? And, what do these discontinuities correspond to?

The evaluation of these questions can take place within an inspection intensity spectrum. There are different ways to progress from a position where a lot of the characteristics of the *scala naturae* are taken for granted, towards a position where the scrutiny is more demanding. Consequently, this amplitude of evaluation means that the assessment may sometimes only concern the internal elements of this scale, or instead it may raise the question of whether the structure itself can be re-arranged with the new philosophical and scientifical developments (which is what, in fact, we will see happening next).

In conclusion, in this way we have drawn up the map of the territory, where the operating field for our investigation is located. The study of the properties of life is concerned with a discontinuity that is detected in the scala naturae in both the narrower and broader sense. At the same time, respectively, it is an interruption inside the region of life and it also concerns the frontier "*esse-vivere*", more specifically the double boundary "*esse-vivere-percipere*".

As we will see, these philosophical and scientific assessments can be posed in either an ontogenetic or phylogenetic setting. The discontinuities concern both the development of a single organism and the distribution of all life-forms. It is here that the debate plays out. Which view best explains these discontinuities? Mechanism or vitalism? Preformationism or epigenesis? Let us start by sketching out how this debate has unfolded.

1.A.4 – 17th and 18th Centuries

How has the mechanism/vitalism debate evolved over the years? Curiously, even though the ideas raised in this discussion are central to all biological thinking, the language we use now did not appear until later in time: "While the term 'vitalism' does not come into actual use until

the late eighteenth century, many of the ideas and concepts embodied in the word are as old as medical and biological thought." (Normandin and Wolfe 2013, p. 6).

Why is this the case? The modern discussion gained traction after the predominantly mechanistic 17th century, born out of classical physics: "the qualitative and teleological approach to physics was abandoned in favour of a mathematical and mechanical description" (Klerk 1979, p.3). This approach expanded from the physical to the life sciences: "After the rise and the great success of classical physics during the 17th century all phenomena of nature, including living organisms, were understood within a new and mechanistic framework." (Klerk 1979, p. 1). This meant that all explanations for the distinctive properties of life were discarded in favour of the mechanistic view: "The seventeenth and eighteenth centuries are predominantly mechanist and rationalist; they tend to reject outright the idea of extra-material forces organizing living things (like the soul, even with its Cartesian meaning). In this period, the analogy with the clock, or with the machine (…) seems to be much more befitting and enlightening in order to grasp the nature of living things." (Brentari 2015, p. 50). Coupled with the dominance of mechanicism, the 17th and 18th centuries were predominantly preformistic. Preformationism "was revived in the 17th century by the early microscopists, who were able to study embryogenesis in stages of development which had not been accessible to observation before. Consequently, Malpighi's studies of chicken embryos and Swammerdam's observations of frog and insect development showed that the embryo was already endowed with some form and hence was not a homogeneous mass." (Mahner and Bunge 997, p. 277).

As a result, where the study of living beings and the properties of life were concerned, the debate heated up: "It was the tension between the teleological and holistic properties of life on the one hand, and the causal-mechanical framework on the other which led to the controversy of mechanism vs. vitalism." (Klerk 1979, p. 1).

Vitalism appeared as a response to the mechanistic movement and as the alternative view: "A renewed interest in organic vitality at the turn of the nineteenth century was the result of several overlapping concerns. The question 'what is life' had, of course, been asked before. But the question acquired a new prominence, if not urgency, in the face of rapid developments in physics and especially chemistry that claimed, at least in part, to answer that question." (Normandin and Wolfe 2013, p. 52). More importantly, the rise of mechanicism took place as a form of anti-Aristotelianism, especially with the rejection of final causes. As a consequence, different authors were driven by this challenge to recover the vitalistic and teleological concepts

originally introduced by Aristotle, reformulating them to the modern context of the debate: "(…) Aristotle formulated a holistic and teleological philosophy of nature" (Klerk 1979, p. 3). Aristotle was again brought to the forefront of this discussion. "Despite the prevalence of the mechanist mindset, vitalism did not disappear in the seventeenth and eighteenth centuries either; as a matter of fact a number of original views emerged alongside the revival of Aristotelian or magical-alchemical concepts (the latter being of Renaissance origin)." (Brentari 2015, p. 51).

One of the key figures in the 17th and 18th centuries, Gottfried Leibniz, is especially notable for what might be termed his vitalist ideas: "On the philosophical side, the vitalist approach is clearly present in the work of Leibniz, who is convinced that mechanism (though influential in physics) fails to account for one of the most characteristic features of living things: harmony. Whether we consider the individual organism, all living beings, or even things on a cosmic level, the harmony of relations between parts can only, according to Leibniz, be explained by allocating vital spontaneity and procedural autonomy to matter. These features come from it being animate matter, i.e. matter in which spiritual realities or monads occur in an immediate and invigorating way. The connection of the monads with one another is ensured by their participation in the God monad, ultimately responsible for harmony in the world." (Brentari 2015, p. 51)

Alongside with the renewal of the vitalistic ideas, the theory of epigenesis supplanted preformationism: "Its revival [of epigeneticism] in the 18th century was a clear reaction to the prevalence of preformationism in the late 17th and early 18th centuries (…). The influence of empiricism and the spread of the experimental method brought about findings that led many embryologists to cast doubts on the truth of preformationism." (Mahner and Bunge 997, p. 278-9).

This is not the place to elaborate on the history of epigenesis. Let it suffice to remember that one of the most important contributions is that of Caspar Friedrich Wolff (1734–1794). He "documented with precision a series of structural changes in the developing chick embryo (…). Accordingly, Wolff's empirical and theoretical work laid the ground for the overall acceptance of the theory of epigenesis and the formation of embryology as the science of developmental processes." (Lux 2017, p. 50).

As mentioned above, given that the mechanistic surge rose against Aristotle's ideas (like the final cause), it is fitting that in the following centuries the vitalistic response was focused instead

on recovering Aristotelian concepts. Historically, according to Driesch, we can look back at Aristotle as the first epigeneticist: "Aristotle knows through various observations that the embryonic parts are not all simultaneously present, but come successively into being; and thus, to use a modern term, we may call his theory 'epigenetic.'" (Driesch 1914, p. 13).

Linked to the resurgence of epigenesis is a new analysis of the organizing principle, or life force: "A first stage in vitalism was the animism of the German physician Georg Ernst Stahl and its reception by the Montpellier medical school in the 18th century. From these debates emerged the conception of a vital or life force, which was introduced into medicine and other life sciences in the 1770s" (Stollberg 2015, p. 2). These ideas were incorporated into experimental practices: "Soon numerous German-language publications appeared providing alternative accounts of the vitality of living organisms, many arguing for the need of a special vital power or Lebenskraft to counter chemical forces and preserve the properties of life." (Normandin and Wolfe 2013, p. 52). The resurgence of vitalism became evident in the 19th century: "Starting in the first years of the nineteenth century, we see a revival of vitalist themes" (Normandin and Wolfe 2013, p. 4).

A central character in this discussion is of course Immanuel Kant. His ideas had a significant influence during the 18th and 19th centuries, and as we will see, he has a central role especially as an influence on Jacob von Uexküll's biological theory. However, despite his importance, a big part of the mechanicism/vitalism discussion does not feature Kant as a major contributor. For this reason, we will not delve into Kant's ideas on this subject. Kant will appear later when von Uexküll is introduced, although regarding not these problems but the ideas of his that shaped the fundamental direction of von Uexküll's thought.

1.A.5 – 19th and 20th Centuries

The 19th century is marked by an increase in the thoroughness of experimental work concerning the study of developmental processes, paired with a theoretical affinity for these questions. Any analysis of the history of embryology and the vitalism/mechanism debate in the 19th century would be lacking without a reference to both Johannes Müller and Karl Ernst von Baer. Not only were their ideas central to the development of the debate (especially in supporting a vitalistic view with serious experimentation) but, as we will see, they were both an important

influence on the views of Jacob von Uexküll. However, this is not the place to expand on their ideas.

Other individuals played a crucial role in developing the experimental approach: "During the 18th and most of the 19th century, embryology merely described what could be seen of the developmental process. This, however, changed with Wilhelm His (1831–1904), Wilhelm Roux (1850–1924), and Hans Driesch (1867–1941) and their systematic experiments with fertilized eggs" (Lux 2017, p. 50). Consequently, during this time, the mechanistic approach to embryology prevailed: "(…) by the mid-nineteenth century, Driesch notwithstanding, vitalism as such had lost much of its significance, as it offered no prospects for a meaningful research program." (Allen 2018, p. 68). Events such as the synthesis of urea in the absence of living beings, in 1828, indicated that "organic substances can be produced out of inorganic compounds, thus invalidating the claim that the chemistry of the living body is categorically distinct from that of inanimate bodies." (Huneman and Wolfe 2011, p. 223).

At the turn of the 20th century, a great number of biologists hoped to place biology on an equal footing with physics and chemistry, and in order to do this "it was essential to break complex organic processes down into their simpler components, in which specific questions could be answered by specific, empirical tests." (Allen 2007, p. 135). As we shall see below, the two most important mechanistic researchers were Roux and Weismann: "Wilhelm Roux (1850–1924) advanced his mosaic theory of embryonic development (also known as the Roux-Weismann theory, after August Weismann, 1834–1914, who had come up independently with a similar view). Their focus had been on the mechanism of differentiation during embryogenesis." (Allen 2018, p. 64). Roux was especially important in developing a 'mechanics of development': "[Roux] understood these mechanisms as basic principles of development upon which he built his developmental mechanics (*Entwicklungsmechanik*)" (Lux 2017, p. 50). Ultimately, at the start of the 20th century, "it was well established that living things were not merely composed of the same substances as ordinary physical objects, but that the principle of conservation of energy applied to them as well. This understanding undermined those remaining doctrines which held that vital forces or energies could direct life activities without themselves drawing upon some energy source." (Hein 1972, p. 169). All these developments took place against the background of Darwinism (and indeed as the dominant paradigm in biological thought).

The resurgence of the mechanistic view in the late 19th century and 20th century owes much to the ideas of Charles Darwin. It should be noted that all that can be said about Darwinism in only a few words runs the risk of being blunt and superficial; nevertheless we should note its contribution. In short, according to the Darwinian view, the phylogenetic distribution of organisms is not driven by an organizing principle. It is simply the result of the stochastic laws of nature, represented by the principle of natural selection acting on the already existing variation of living beings. Similarly, the development of organisms does not require the guidance of a vitalistic principle. The mechanistic view thus gained a new impetus: "The *vera causa* of organic change and progress appeared to be Natural Selection, an external factor operating on organisms *ab extra*, in the same way as physical or dynamical forces are impressed on bodies or their parts from the outside. Mechanical analogies began to be applied, and Evolution came to be looked upon as the mechanics of organic development – *Entwicklungsmechanik*, as it has been called by Wilhelm Roux. The whole tendency of Darwinism has therefore been to vastly add to the dominance of the mechanistic hypothesis, which has through it come to extend its sway from the kingdom of matter to that of life." (Smuts 1927, p. 197).

Darwinism marks a major milestone in the history of this problem, not least because it explores the possibility of dissociating mechanicism from the preformationist view. In other words, the fundamental aspects of epigenesis are reconciled with those of mechanicism, given that innovation in life forms is not denied, but the factors producing variation are entirely compatible with a reductionist, strictly physico-chemical world. Furthermore, Darwinism played a hegemonic role and set the paradigm for mainstream biology in the second half of the 19th century, the result being that other competing ideas were naturally side-lined.

Accordingly, as we will see, Darwinism was turned into the field of battle: as Neovitalism rose against mechanicism, the discussions took place in a Darwinist context. This time Neovitalism employed the same tool that had been previously used against Aristotle's ideas: experimental knowledge.

Before we move on, we should note that several decisive contributors to these topics have been left out: names such as Lamarck, Haeckel etc. The reason is that we are not attempting to produce a synopsis of the history of biology in the 19th century. Their contribution is acknowledged, but it is outside the context of this work.

1.A.6 – Rise of Neovitalism

After a more mechanistic-inclined 19th century, the door to a renewal of vitalism remained nonetheless open. The properties of life remained a mystery even under the popular mechanistic approach to the life sciences: "The way was kept open for the new vitalism to operate as soon as biological research flowed again over the 'world of life' instead of being mainly confined to the narrow channels which the mechanist school takes for Newton's ocean of truth" (Wheeler 1939, p. 123). The shortcomings of the mechanistic approach came to light: "By the 1890s, with Darwinism in a perceived crisis and new sciences like embryology in ascendance, the capacity of organisms to develop, change, and heal themselves was being targeted (as earlier noted) as an insurmountable barrier to any attempt to extend principles of physics and chemistry to life. In Germany and elsewhere, a range of scientists had begun to argue for an outright rejection of the model of the machine in the life sciences. The hope that the study of life could be pursued using concepts out of the physical sciences must be abandoned, they said; new theoretical assumptions must be developed to guide research into living processes" (Harrington 1996, p. 48).

In opposition to the dominant mechanistic views at the time, a new approach to vitalism therefore appeared. This philosophical movement "rejected the predominating role of the causal-mechanical way of thinking" (Klerk 1979, p. 7). As mentioned before, one of the major contributors to this revival was Hans Driesch: "The rebellion against this fortress of rigor [that all science must necessarily limit itself to mechanistic modes of explanation] began with the fin de siècle revival of vitalism in early-twentieth-century biology, primarily associated with the work of Hans Driesch. Through its showcasing of research results in embryology, Driesch's new vitalism declared that the inability of mechanism to account for the incontrovertible results of laboratory research justified a turn to alternative formulations." (Harrington 1996, p. xvi). In his own words: "It is due to its enemies that Vitalism once more raises its head. The best opponents of traditional Vitalism have actually been of direct service in causing its re-birth; they purified it of many errors and it became all the more clear that there is a kernel of truth at its core." (Driesch 1914, p. 171).

As in the previous centuries, Aristotle is revived by Driesch to support his vitalistic ideas: "(…) not only is [Aristotle] a typical representative of antiquity and the Middle Ages, but also a typical precursor of all vitalistic theories until the most recent times." (Driesch 1914a,

p. 12). The homage becomes clear when Driesch develops the concept of *Entelechy*: "We shall use this word only as a sign of our admiration for [Aristotle's] great genius; his word is to be a mould which we have filled and shall fill with new contents." (Driesch 1908, Vol. 1, p. 144).

This view was called Neovitalism. "Embryological ideas explored by thinkers like Hans Driesch became the basis for new neo-vitalist perspectives" (Normandin and Wolfe 2013, p. 8). And: "In these lectures, published both in English (1908) and in German (*Philosophie des Organischen,* 1909), he propagated his concept of life, known as Neo-Vitalism (neo- as distinct from the bona fide vitalism holding sway before the rise of cell and developmental biology late in the nineteenth century)." (Sander 1997, p. 36).

According to Driesch, the emergence of neo-vitalism was possible due to the contributions of Roux in producing a mechanical theory of development: "The cause of the real establishment of Neovitalism was, as we have mentioned, the reappearance of experimental morphology, the 'mechanics of development' [Entwicklungsmechanik] represented by W. Roux." (Driesch 1914, p. 171). "(…) Although Roux himself was not explicitly a vitalist, he developed the 'mechanics of development' in which Driesch found new experimental support for considering that the vitalistic view of life is the true one" (Wheeler 1939, p. 127).Neo-vitalism was thus characterized by the recycling of older vitalistic ideas, now supported by serious experimental practice, following Roux's work: "A vitalistic current originated which was not just a resuscitation of the older doctrines of vital energies, but in some respects different from them, and it was therefore called (…) Neovitalism. Its defenders did not only theorize but endeavoured to prove their vitalism by facts and experiments; they tried to bring the vital forces into accord with the law of conservation of energy" (Van der velt 1943, p. 137). In Driesch's words: "The experiments of several years upon the power which organisms possess of regulation of form, and continual reflection on the collective results of experiments on the physiology of development, upon which I had been working since 1891, combined with a logical analysis of the concepts of 'regulation' and 'action', brought about an entire change of my opinions and the gradual elaboration of a complete system of Vitalism." (Driesch 1914, p. 177).

Ultimately, we can return to Heidegger's commentary: "Driesch was thus driven by his experiments to adopt his biological theory, known as neovitalism, which is characterized by the appeal to a certain force or entelechy" (Heidegger 1995, p. 262). In summary: "In his 1914 work *The History and Theory of Vitalism*, Hans Driesch developed a new philosophical position

– “neo-vitalism” – which not only borrowed from Aristotelian metaphysics (in particular the concept of entelechy), but which also outlined many characteristics that vitalistic theories share: irreducibility, temporality, autonomy, purposiveness and wholeness.” (Normandin and Wolfe 2013, p. 104).

1.A.7 – Jacob von Uexküll and Neovitalism

Because of his pivotal role in articulating a new version of vitalism, Driesch is generally considered its flagbearer: “The most influential contemporary spokesperson for this position was (…) Hans Driesch” (Harrington 1996, p. 48). “To many a modern biologist or thinker conversant with the problem of the nature of life, an examination of the neo-vitalist position is practically identified with the study of the views of Hans Driesch.” (Smith 1955, p.186). Nevertheless, alongside Driesch and at the same time, we find several authors that were included in the neo-vitalistic group, including Von Uexküll: “Neovitalism, with its set of concepts related to self-organisation, was one of the central views that many of the greatest minds in biology shared at the beginning of the 20th century.” (Magnus and Kull 2009, p. 123). “The neovitalist approach has among its fundamental traits the aspiration to prove experimentally the existence of the organizing instance that underlies living things, and which is given different names depending on the author: vital force for Bernard, entelechy for Driesch, dominant force for Reinke, natural factor for Uexküll.” (Brentari 2015, p. 53).

After this brief sketch of the historical course of the mechanist-vitalist debate, we therefore reach the question we posed at the start: is it fair to place von Uexküll in the neo-vitalist group along with Driesch? How far is this “historical judgement” correct? “Driesch and Uexküll were unquestionably the most influential authors bringing neo-vitalism to early twentieth-century German biology” (Rieppel 2016, p. 142). “(…) Uexküll’s name has been listed as the second one after Driesch in the articles about neovitalism in several encyclopaedias.” (Favareau 2010, p. 425).

As we shall see, there is definitely some affinity between them, especially since von Uexküll was supportive of the neo-vitalist view (Magnus and Kull 2009, p. 123). Some authors defend this pairing by highlighting the similarities between the anti-mechanistic concepts developed by Driesch and von Uexküll: “By the time Driesch gave the Gifford lectures [1908], Uexküll had produced the studies on *Sipunculus* that led him to propose the existence of a teleological principle (the Bauplan) much like Driesch's entelechy.” (Harrington 1996, p. 52).

Rieppel adds: “In his obituary for Hans Driesch, Curt Herbst sketched Driesch’s influence on Uexküll, and claimed to have immediately recognized that the latter’s doctrine of conformity to plan is nothing else but a rewording of Driesch’s doctrine of Entelechy, ‘for design implies its goal’” (Rieppel 2016, p. 141).

However, despite these statements, not all authors agree with this analysis. There is some resistance to considering von Uexküll a neo-vitalist like Driesch, as seen in the previous comments made by Thure von Uexküll, his son. Other authors support this view: “The point, however (…) is that Uexküll didn’t identify himself as a vitalist” (Magnus and Kull 2009, p. 123). This means that, despite the affinities between both authors, von Uexküll did not completely agree with Driesch’s ideas: “Driesch's journey into denser philosophical thickets was problematic for Uexküll. Increasingly, the latter shied away from making explicit use of Drieschian concepts like entelechy and psychoid and later privately admitted that he found many of Driesch's philosophical arguments ‘too abstract,’ ‘beyond my anschaulichen horizon.’ As time went on, probably more than mere terminological differences separated him from his old friend, in spite of Driesch's late conciliatory assertions to the contrary”. (Harrington 1996, p. 52).

How can we therefore characterize von Uexküll’s ideas? How does von Uexküll’s position fit with the anti-mechanistic ideas of his time? Weiss summarizes: “Uexküll wishes to replace the mechanistic science of living nature by an interpretation and investigation based on the obvious though immaterial phenomenon of a plan (Planmässigkeit, Plan) in nature. He stamps physiology, i.e. the physical and chemical investigation of plants and animals, as purely mechanistic and therefore missing the basic character of a true biology, whose concepts and methods of investigation must be directed by a grasp of the central life-phenomenon, the plan. This insight has not only come to him by free observation of nature, but has been confirmed by experiment.” (Weiss 1948, p. 48)

Does von Uexküll defend a neo-vitalistic perspective, like Driesch? In order to better understand this issue, let us first expand on the ideas of both authors. This is the focus of Part 1. Then, in Part 2, we should be in a position to compare both authors more carefully in order to answer our questions.

Chapter 2 – Hans Driesch: From *Entwicklungsmechanik* to Entelechy

2.A – Biography

Hans Driesch was born in October 28 1867, in Bad Kreuzach, Germany as "the only child of a well-to-do family, the father a merchant from Hamburg where Driesch grew up" (Rieppel 2016 p. 121). "After graduating from the *Gelehrtenschule der Johanneums* (Grammar School) in Hamburg in 1886, he decided he wanted to become a zoologist." (Allen 2008, p. 54). "He spent one year (1886-1887) studying at the University of Freiburg with August Weismann (1834-1914), and in 1887 he graduated at the University of Jena to pursue his doctorate under Ernst Haeckel (1834-1919)." (Allen 2008, p. 54).

At Jena Driesch met Curst Herbst (1866-1946) with whom he would become a close friend and collaborator, and with Driesch being independently wealthy, they were able to set out on prolonged travel programmes (Rieppel 2016, p. 121). "When Driesch came to Jena in 1886 as a nineteen-year-old, he was—much like Uexküll—a heartfelt admirer of Darwin and Haeckel." But "during the previous year or two [after 1891], influenced (as he explained) by the arguments of biologists G. Wolff, W. His, and A. Goette, Driesch had already undergone a process of disenchantment with certain of the dogmas in Haeckel's Darwinism." (Harrington 1996, p. 48).

After finishing his doctoral degree in 1889 Driesch started his crucial experiments (Allen 2008, p. 54). Driesch "began his studies of sea urchin embryos during his field trips to Lesina in the late summer of 1890 and Trieste biological station (in 1891)" (Valsiner 2017, p. 34). Starting in the fall of 1891 Driesch eventually reached the Zoological Station in Naples. "Established in 1874 by the German morphologist Anton Dohrn (1840-1909), the Naples Station (as it was referred to in English) had become one of the most important marine laboratories in the world." (Allen 2008, p. 54). Curt Herbst was already located there, and it was also where he met Jacob von Uexküll. "It was at the Naples Zoological Station that Driesch carried out most of his best-known experiments" (Allen 2008, p. 54)

However, "by 1900, Driesch had more or less abandoned a full-time career as an experimentalist and had settled in Heidelberg (virtually next door to the Uexküll family) with the aim of comprehensively working out the philosophical justification for a vitalist perspective." (Harrington 1996, p.51-52). In 1907 Driesch was invited to give the Gifford Lectures at the University of Aberdeen. "These lectures were written by Driesch first in English as *The Science and Philosophy of the Organism* (Driesch, 1908), and later translated (by himself) into German (Driesch, 1909)" (Valsiner 2017, p. 37). This opportunity allowed him to engage in "comprehensively working out the philosophical justification for a vitalist perspective" (Harrington 1996, p. 51-52). "He moved to the University of Cologne in 1920 for a brief period, prior to taking over the philosophy chair at the University of Leipzig in 1923, where he stayed for the rest of his university career; this ended in enforced retirement in 1933, on the Nazi takeover of most of the universities in Germany" (Valsiner 2017, p. 37)

2.B – The Experimental Discoveries of Wilhelm Roux and Hans Driesch

2.B.1 – Roux's Entwicklungsmechanik

Before the presentation of his experimental results, Wilhelm Roux set out to describe the characteristics of *Entwicklungsmechanik* (Developmental mechanics). He produced these ideas in two series: first in an 1885 article (*Beiträge zur Entwicklungsmechanik des Embryo*) and later in a revision of it in 1897 (*Programm und Forschungsmethoden der Entwicklungsmechanik der Organismen*). Roux's first programmatic writings from 1885 are generally mentioned as the

starting point for Embryology as a modern discipline of biology (Waisse-Priven 2009, p. 35). Roux founded a new journal (*Wilhelm Roux's Archiv für Entwicklungsmechanik der Organismen*) edited by himself, through which he would additionally support his cause (Maienschein 2013, p. 56)

Entwicklungsmechanik is the approach characterized by the causal-analytic method coupled with experimentation. According to Roux, "experimentation (…) is the proper causal method of investigation. And given that causal investigation is the only legitimate study for science, experimentation must be the only method for science. (Maienschein 2013, p. 56).

Embryonic development is particularly difficult to study with direct observation, Roux insisted, because the processes and patterns lie largely hidden from sight within the embryo and change very quickly. (Maienschein 2013, p. 56). The descriptive methods used until that time (as by, for example, Karl Ernst von Baer and Johannes Müller) were not enough to give a full account of the aspects of ontogeny. "This approach was unable to probe into the internal aspects of these processes, which were unavailable to direct observation and, therefore, required inductive and deductive inferences grounded on the notion of causality" (Waisse-Priven 2009, p. 38).

The first aspect of *Entwicklungsmechanik* was the adoption of an epistemic focus on the causal analysis of embryologic development. Roux assumed that the processes of development and other living functions are mechanistic and can be understood in mechanical terms, which conform to general rules of mechanical causation (Maienschein 2013, p. 56). This approach focused on the discovery of the immediate, or proximate, causes of particular processes such as differentiation (Allen 2008, p. 58).

Additionally, *Entwicklungsmechanik* is characterized by the methodological focus on experimentation. According to Roux, this approach was built from the union of both descriptive and experimental analysis. Neither of them was complete in itself, but together they allowed the investigator to reach the goal of explaining organic morphogenesis (Waisse-Priven 2009, p. 38). In Roux's words: "We shall never see either approach completed; however, we shall have to attend continuously to both in order to approach our aim in both ways; the required combination of both tasks might be termed *Entwicklungsmechanik des Embryo*" (Roux 1885, p. 413; quoted in Sander 1997, p .2)

Experimentation allows an investigator to watch processes at the same time as they are occurring (which does not happen in, for example, cytology, where the organisms have to be

killed and processed for analysis). It also allows for the comparison between natural cases and experimental ones, where the investigator can alter some factors in the development of an organism and observe the differences at a later stage (Maienschein 2013, p. 56).

By 1900 the experimental approach was widely considered the proper one for embryological research and, combined with the goal of searching for the causes of developmental change, "developmental mechanics could answer tough questions and could begin to achieve a certainty as physics did, as an 'exact science.'" (Maienschein 2013, p. 56). "Henceforth, they said we must work in a way that our results and conclusions can be tested; can be verified or refuted. We must be able to say: such and such things happen under such and such conditions, and, if you don't believe it, you supply the conditions, try it for yourself, and you will find it to be true. But this is precisely what experimentation is; and so they flocked with enthusiasm to experimentation." (Jennings 1926, p. 98; quoted in Maienschein 2013, p. 59)

2.B.2 – Roux: Frog Embryo Experiments

At a pathological anatomy meeting in Wiesbaden on September 22, 1887, Roux presented for the first time the experiments that made him famous. These were later published in 1888 (Rieppel 2016, p. 119). Roux argued that in each cell the nucleus contained several units, encoding between them all the traits of the organism, the determinants. The first cell contains all the determinants of that organism, provided by the combination of its parental cells. Consequently, through the processes of nuclear cell division during development, the different determinants are separated into the different daughter cells as the embryo is formed. This means that in each generation the cell receives increasingly specialized determinants such that, by the end of differentiation, each cell contains only the ones that determine its specific characteristics (Allen 2017, p. 64). As Driesch would later describe it, there is: "a very complicated structure which promotes ontogeny by its disintegration, carried out during the cell divisions of embryology with the aid of the process of nuclear division" (Driesch 1908 Vol 1, p. 59). A mosaic pattern is therefore produced where "each resulting piece is different in that it has different bits of nuclear material from the others though it maintains its individuality and also remains part of a larger picture" (Maienschein 2013, p. 48).

With this hypothesis as the starting point, Roux produced a series of experiments where he hoped to observe what the effect of a loss of cells in the embryo would be to the rest of its

development. “The fundamental assumption that specific cells performed specific functions and further, that the loss of these cells would result in incomplete development, was based on the mechanist view that since structure determined function, a loss of structure must be accompanied by a loss of function.” (Innes 1973, p. 37). In Roux’s words: “The following investigation represents an effort to solve the problems of self-differentiation – to determine whether, and if so, how far, the fertilized egg is able to develop independently as a whole and in its individual parts. Or whether, on the contrary, normal development can take place only through direct formative influences by the environment on the fertilized egg or through the differentiating interactions of the parts of the egg separated from one another by cleavage.” (Roux 1888, quoted in Maienschein 2013, p. 49)

In these experiments, Roux selected frog embryos at the initial stages of development and, with a hot needle, pierced a single blastomere at the two- or four-cell stage, or sometimes two blastomeres at the four-cell stage, consequently killing those cells (Sander 1997, p. 13). He then watched these embryos develop. Roux observed that the surviving blastomere grew and produced a partial embryo, like a fully developed embryo cut in half, which advanced to either the blastula or the gastrula stage and no further. (Maienschein 2013, p. 51).

By observing that there was no compensation for the dead blastomere, Roux stated: "In general we can infer from these results that each of the two first blastomeres is able to develop independently of the other and therefore does develop independently under normal circumstances." (Roux, 1888, pp. 25-26; quoted in Maienschein 2013, p. 51). Roux’s viewed these results as confirmation of his mosaic pattern hypothesis (Allen 2008, p. 61). The first steps of development are given by the differential nuclear division and independent self-differentiation of the blastomeres. “The following principle could therefore be established: the development of the gastrula and of the embryo initially produced from it is, from the four blastomere stage of the egg on, a mosaic of at least four vertical pieces [the four blastomeres] each developing substantially independently" (Roux 1888, p. 289; quoted in Sander 1997). This new hypothesis became known as the mosaic theory of development (Allen 2008, p. 58; Maienschein 2013, pg. 50).

Figure 3

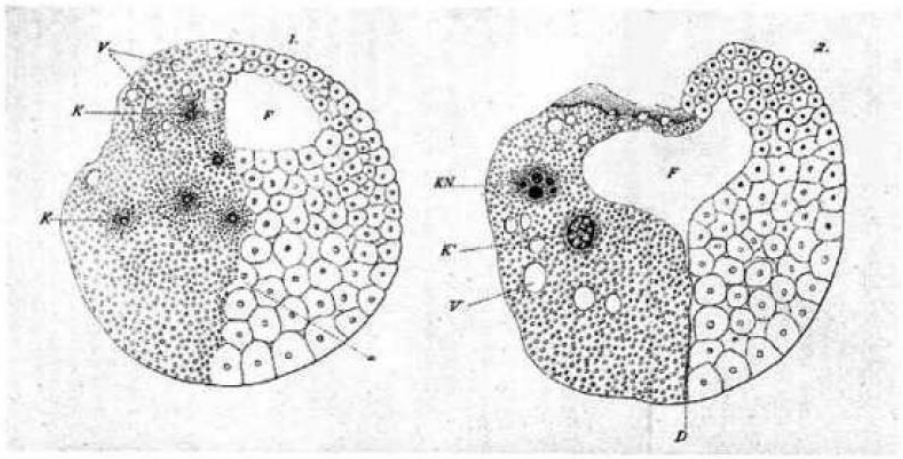


Figure 3 – Roux's experiment – “Roux killed (with a hot needle) one of the first two blastomeres of the frog embryo. The other blastomere divided normally, producing a half-blastula state (the right-hand side of the embryo); the heat-killed blastomere gave rise to an amorphous mass of protoplasmic material and cell nuclei (the left-hand side of the embryo).” (Roux 1888; adapted from Allen 2008)

A similar view had been put forward by August Weismann in the 1870s. Weismann also postulated that the hereditary units exist in the nucleus and developed a mechanism for their separation during development. Although Weismann’s and Roux’s ideas differed in some respects, they shared the main idea of the hereditary determinants and their functioning, which allowed the development of this wide-ranging theory. It became known as the Roux-Weismann mosaic theory. (Allen 2008, p. 58; Maienschein 2013, p. 49)

It should be noted, as Roux mentions, that the mechanism of mosaic development is not necessarily the only mechanism at work. As he continued with his experiments, he realized that this mosaicism applied “only for normal (…) development, and strictly speaking only for its earliest stages, while seeing ample proof of interactive mechanisms in abnormal (…) development after experimental interference” (Sander 1997, p.13). In Roux’s words: "How far this mosaic formation of at least four pieces is now reworked in the course of further development by unilaterally directed rearrangements of material and by differentiating

correlations, and how far the independence of its parts is restricted, must still be determined." (Roux 1888, p. 25-26; quoted in Maienschein 2013).

He discovered some cases that did not align with his initial theory but instead of revising his mechanism he developed alternative hypotheses. For example, in a few cases, a whole frog developed from the surviving blastomere. Roux postulated that there was a reserve idioplasm (or set of nuclear materials) that came into action in the special cases of regeneration (Maienschein 2013, p. 51). In light of these discoveries, he concluded that mechanisms other than mosaicism must exist, both in normal and abnormal development (Sander 1997, p.13)

2.B.3 – Hans Driesch: Sea Urchin Embryo Experiments

The way that Hans Driesch found out about Roux's experiments was recalled by himself: "(...) accidentally, the inaugural speech at Innsbruck by the anatomist Roux – of whom I only knew the Darwinist writing 'The Struggle of Parts in the Organism' – titled: 'The Mechanics of Development, an Anatomic Science of the Future.' [*Die Entwicklungsmechanik, eine anatomische Wissenschaft der Zukunft*] – fell into my hands. Here he explained the kind of experiment to be conducted in embryological research. He himself had obtained with it an important result (...) [which] agreed with Weismann's theoretical views: in the course of segmentation, the machinery constituting the basis for embryo development is divided into its parts. This was no longer a mere hypothesis, but an experimental fact. I decided to pursue my own work in this context." (Driesch 1951, p. 68; quoted in Waisse-Priven 2009, p. 37)

Driesch followed the call for just the sort of causal, mechanical accounts of individual development that Roux was pursuing (Maienschein 2013, p. 51). He decided to replicate Roux's experiments, albeit with slight differences: he used sea-urchin embryos (and not frog embryos) and, instead of piercing the early stage embryo with a hot needle (killing the targeted blastomere), he used a shaking method to separate the cells from one another.

Driesch observed that by shaking the embryo at the two-cell stage, and thereby separating the blastomeres, Roux's outcome was not replicated: instead of two half-embryos one observed the development of two pluteus larvae, complete, but with half the size of a normal larva (Rieppel 2016, p. 125; Churchill 1969, p. 166) (see Figure 2). "I was so much convinced that I should get Roux's morphogenetical result in all its features that, even in spite of this whole blastula, I now expected that the next morning would reveal to me the half-

organisation of my subject once more (…). But things turned out as they were bound to do and not as I had expected; there was a typically whole gastrula on my dish the next morning, differing only by its small size from a normal one." (Driesch 1908, Vol. 1, p. 61).

Driesch does not observe any evidence for the splitting of the nuclear determinants, as postulated by Weismann and Roux. It appears that each blastomere contains all the determinants for the development of the whole organism (Allen 2008, p. 59). "It seemed, after all, that the cells each retained what Driesch called a 'totipotency', or the ability to respond to the needs of the whole and to become any part of the whole that the conditions demanded. (Maienschein 2013, p. 51). "(…) one of the first two blastomeres (…) had become a whole organism by a simple process of rearrangement of its material" (Driesch 1908 Vol 1, p. 61). This result led Driesch to disprove Roux's theory of mosaic development.

Figure 4

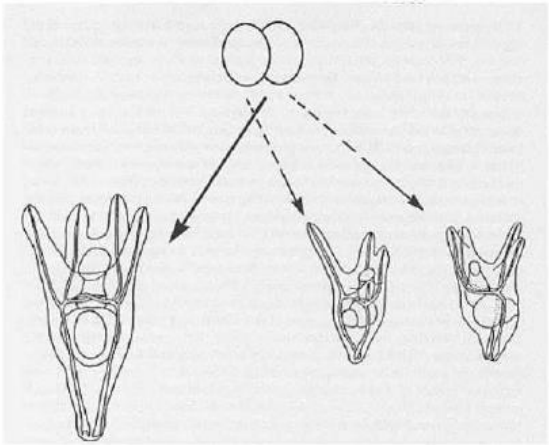


Figure 4 – Driesch's experiment – "Driesch separated (by shaking) the first two blastomeres of the sea urchin egg, leading to the production of two smaller-sized but complete pluteus larvae (right-hand side, dotted arrows). If the two cells remained together they produced one large pluteus (left-hand side, solid arrow)" (Adapted from Allen 2008)

Driesch additionally countered mosaicism with further experiments in the following years. Instead of separating the blastomeres, he experimented with squeezing a four-cell stage embryo between glass plates, in order to induce the unequal distribution of nuclear material during cell division. Once again, no abnormalities were found and a normal looking pluteus developed

(Rieppel 2016, p. 125; Sander 1997, p. 31). Changing the characteristics of the surrounding medium also had no effect on the developed larvae: “By raising the temperature of the medium or by diluting the sea-water to a certain degree it proved at first to be possible to alter in a rather fundamental way the type of the cleavage-stages without any damage to the resulting organism.” (Driesch 1908 Vol. 1, p. 62-63)

Interestingly, the different results Roux and Driesch obtained were later reconciled by Driesch repeating Roux's experiment, but now by separating the blastomere killed by the heated needle from the living one. Under these conditions the normal blastomere developed into a complete frog larva. (Allen 2008, p. 62). This subtle but crucial difference removed all doubts that might have remained about the heat-killed blastomere affecting the outcome of the surviving one.

2.C – From Mechanics to Teleology

2.C.1 – Hans Driesch: New Experiments

In the years following his initial attempt to replicate Roux’s experiment, Driesch immersed himself in an intense phase of experimentation where he expanded on his initial discoveries. The different experiments mentioned above took place during those years (the use of the deformation method on the 4-cell stage embryo, changing the temperature and diluting the sea water etc.). A few years after the first set of experiments, Driesch published two books where he described and reflected on his discoveries. In 1893 “*Die Biologie als selbständige Grundwissenschaft*“, and in 1894 “*Analytische Theorie der organischen Entwicklung*“.

As mentioned above, Driesch’s initial fascination with Roux’s approach led to the adoption of Roux’s *Entwicklungsmechanik*. This meant the combination of the latter’s experimentation and descriptive methods in the search for the internal causal factors of development. In his 1894 work, Driesch mentioned that his aim was to break down, by "causal analysis", the continuous process of animal morphogenesis into its ultimate elements (Sander 1997, p. 32). "For every variation which appears, we inquire a priori about a cause."[11] (Driesch 1894, p.32).

[11] Für jede auftretende Verschiedenheit fragen wir aber a priori nach einer Ursache.

As he had mentioned back in 1891: "(…) strictly speaking, the mechanical approach intends to demonstrate that any group of phenomena within the scope of a problem is not peculiar to it, but rather, under certain conditions, is an expression of physically known causes"[12] (Driesch 1891, 10). It is possible to understand the processes of development if they are, in their basis, explained by chemical processes: "But if the morphogenic elementary processes in their totality make up the whole of the effects of ontogenesis upon what happens and thus [make up the whole] result of ontogenesis, then we can say that the result of ontogenesis comes about through chemical stages. Consequently, this sentence means that the effect of every elementary ontogenetic triggering is a chemical one, which has physical and therefore morphological consequences (growth etc.)."[13] (Driesch 1894, p. 43-44). What then were the causes, or better still, the elementary cellular processes upon which Driesch could substantiate his developmental model?

2.C.2 – A New Mechanism

As mentioned above, the Roux-Weismann hypothesis proposed that the mosaic development of the embryo was due to qualitative nuclear division: with each cell division the number of determinants was split into different daughter cells, so that in a fully-formed organism, each specialized cell contained a unique composition of determinants. Driesch also argues that the nucleus plays the dominant role in directing the chemical changes underlying the processes of development. However, he does not agree with Roux's and Weismann's ideas. His stance is that all nuclei contain the totality of the determinants (Driesch 1894, p. 43). The nucleus contains a mixture of determinants (or ferments, as Driesch calls them) that are going to be activated by incoming stimuli and produce a response in that cell. The formative stimulus, or impulse, does not come from the nucleus itself, but from outside of the cell (Sander 1997, p. 33). However, how is it possible that differentiation happens if the nucleus always contains the totality of the determinants?

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[12] (…) unter mechanischer Betrachtungsweise im engeren Sinne verstehen: den Nachweis, daß irgend eine Erscheinungsgruppe innerhalb eines Problems nichts ihm spezifisch eigentümliches ist, vielmehr bei gewissen Voraussetzungen als Ausdruck physikalisch bekannter Ursachen sich darstellt.

[13] Wenn aber die morphogenen Elementarvorgänge in ihrer Gesammtheit das Ganze der Geschehenseffekte der Ontogenese ausmachen und damit das Resultat der Ontogenese, so können wir sagen, das Resultat der Ontogenese komme durch chemische Phasen zu Stande. Es bedeutet dieser Satz also, dass der Effekt jeder elementaren ontogenetischen Auslösung ein chemischer ist, welcher physikalische und somit morphologische Folgen hat (Wachstum etc.).

In order to answer this question, Driesch produces one of his most important speculations. The cytoplasm acts as a selective intermediary between cell-external stimuli and the nucleus: "(…) the assumption of the local separation of receiving and responding stations for the original triggering organogenic stimulus."[14] (Driesch 1894, p. 89). That is, in the cell, the reception of the stimuli and the corresponding response do not happen in the same place. The cytoplasm receives the stimulus and ultimately triggers the nuclear response. This means that the state and the capacity of the cytoplasm is what determines the fate of the cell, and consequently means that the progressive restriction of the possible fates of the cells is not a nuclear but a cytoplasmic problem (Churchill 1969, p. 171). "With this we solve the apparent contradiction we just discovered: insofar as it has a nucleus, each cell of ontogenesis is in fact the bearer of the totality of all embryonic primordia, but, insofar as it has a specific plasma body, it is only able to receive certain causes through this very body; since the response to a cause presupposes its reception, it can therefore as a whole only respond to certain causes each time."[15] (Driesch 1894, p. 81).

In summary, Driesch states: "(…) the organogenic substances that determine the individual elementary process do not emerge directly from the nucleus at all, but only develop in the protoplasm under its direction. However, we regard this control of the nucleus as a fermentative effect. We therefore let the nucleus be a mixture of ferment-like substances, each of which represents an elementary process type of the present ontogenesis. By means of a triggering process one of these ferments is put into action, and the reason why this can be a certain specific ferment is because the protoplasmic body, which acts as a stimulus receiver, as an intermediary between stimulus and response, has a specific chemical composition"[16] (Driesch 1894, p. 88).

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[14] (...) liegt in der Annahme der lokalen Trennung von Empfangs- und Antwortsstation für den ursprünglich auslösenden organogenen Reiz.

[15] Hiermit nun lösen wir den soeben aufgedeckten scheinbaren Widerspruch: insofern sie einen Kern besitzt, ist jede Zelle der Ontogenese in der That Trägerin der Totalität aller Anlagen, insofern sie aber einen spezifischen Plasmaleib besitzt, ist sie, eben durch diesen, nur befähigt, gewisse Ursachen zu empfangen; sie kann daher als Ganzes, da zur Antwort auf eine Ursache doch deren Empfang vorausgesetzt ist, jedesmal auch nur gewissen Ursachen antworten.

[16] (...) wenn wir annehmen, dass die organogenen, den einzelnen Elementarprozess bestimmenden Stoffe gar nicht unmittelbar aus dem Kern hervorgehen, sondern nur unter seiner Leitung im Protoplasma entstehen. Diese Leitung des Kernes aber sehen wir als eine fermentative Wirkung an. Wir lassen also den Kern ein Gemenge von fermentartigen Stoffen sein, deren jeder eine Elementarprozessart der vorliegenden Ontogenese repräsentiert. Durch einen Auslösungsvorgang wird nun ein bestimmtes dieser Fermente in Aktion versetzt, und zwar kann das ein bestimmtes spezifisches Ferment sein, weil ja der Protoplasmaleib, der als Reizempfänger, als Mittler zwischen Reiz und Antwort fungiert, einen spezifischen Chemismus besitzt.

2.C.3 – *E Pluribus Unum*

As mentioned above, Driesch's experimental undertaking had the objective of discovering the internal causal factors of development. However, even though he was able to produce a completely mechanistic explanation of embryogenesis, his experimental work led him to confront events that could not be understood within this framework. (Churchill 1969, p. 173; Waisse-Priven 2009, p. 46). "Unsatisfied with the vague, unclear and unfounded fantasies of our modern biological research, I was initially drawn to the few attempts that call themselves exact; this led me to an analysis of these 'mechanistic' endeavours, but, at the same time, already to some doubt about their value for the real biological questions."[17] (Driesch, 1894, p. v).

His dissatisfaction applied to the entire causal-analytical framework of the mechanistic approach. Organisms could be compared to machines since mechanics was able to explain the production of the parts and the action of the whole. But this analogy could not explain why organisms were structured in a certain way (Churchill 1969, p. 173; Waisse-Priven 2009, p. 48). "One has indeed expressed the opinion that every stage of ontogeny is the necessary consequence of the preceding stage and the cause of the following one; this sentence, however, is not to be accepted without further ado, for ontogeny is not a united process but is a combination of many processes which are not only in part totally separate from one another but in this independence are actually "given" processes. In other words, we understand (…) these processes only in part by understanding their causes. We must therefore explain (…) ontogeny as a causal regularity striding along in a pronounced mystery; causal analysis of ontogeny leaves us only fragmentary pieces" (Driesch 1984, p. 128; quoted in Churchill 1969, p. 173). What is the mechanical causal analysis failing to account for? Allen says: "As Driesch explained his dilemma, it was as if he had entered a shipyard where he saw structures lying all about him but could make no sense of the construction process until he knew the ultimate purpose of each piece, that is, how it functioned with respect to the completed ship." (Allen 2008, p. 60).

[17] Unbefriedigt von den unbestimmten, unklaren und unbegründeten Phantasien unserer modernen, biologischen Forschung zogen mich zunächst die wenigen Versuche an, welche sich selbst exakt nennen; das führte mich zu einer Analyse dieser »mechanischen« Bestrebungen, gleichzeitig freilich schon zu einem Zweifel an ihrem Wert für die eigentlich biologischen Fragen.

What Driesch is arguing is that it is possible to analyse and describe the various processes of development, but we can only understand them with reference to the whole (Innes 1973, p. 40). A new category has to be introduced: Teleology. Mechanical explanations are ultimately insufficient and "(…) it is the teleological point of view of judgment that takes hold where the causal point of view and the point of view of logical explanation end."[18] (Driesch 1893, p.50). In fact, the development of organisms is the clearest example of teleology in nature: "How can one explain the apparent teleology of development where the end seems to be in view from the beginning? (…) From beginning to end it appears that development is moving toward a goal." (Conklin 1929, p. 31)

In order to fully understand the ontogeny of individuals, a teleological view is necessary. "In other words: on the basis of an objective compulsion, namely because the viable whole is given as the clearly recognizable end of the totality of all processes of ontogenesis, we judge these processes as if they were determined by an intelligence according to quality and order. With these words we give the critical-teleological point of view a truly adequate expression."[19] (Driesch 1894, p. 131).

2.D – Not Just Teleology but Also Vitalism

How is the fate of the developing embryo determined if we frame it inside a teleological category? In order to explain the process of differentiation of the embryo, Driesch introduces two concepts in his 1894 book: *prospective potency* and *prospective value*. Prospective value is the actual fate of a certain element. Prospective potency is understood as the capacity of a specific element to develop its possible fates through different paths (Driesch 1908 Vol. 1, p. 76). As the embryo develops, the ability of each part to follow the original developmental plan becomes more restricted; that is, the number of possible fates for a certain element reduces with time and, thus, the prospective potency diminishes. Eventually, in a fully formed organism, the prospective potency of all organs is zero (Churchill 1969). This also means that at any point in

[18] (...) der teleologische Gesichtspunkt der Beurteilung ist es, der Platz greift, wenn der kausale und der logisch begründende mit Notwendigkeit im Stiche lassen.
[19] Anders gesagt: Wir beurteilen auf Grund einer objectiven Nötigung, nämlich deswegen, weil das lebensfähige Ganze als deutlich erkennbares Ende der Gesamtheit aller Prozesse der Ontogenese gegeben ist, diese Vorgänge so, als seien sie von einer Intelligenz nach Qualität und Ordnung bestimmt, mit diesen Worten geben wir dem kritisch-teleologischen Standpunkt den eigentlich adäquaten Ausdruck.

development “there are more morphogenetic possibilities contained in each embryonic part than are actually realised in a special morphogenetic case” (Driesch 1908 Vol. 2, p. 76).

In the Roux-Weismann mosaic theory, the fate of each blastomere in the embryo is determined by the mixture of determinants resulting from the progressive nuclear divisions during development. But as we saw above, Driesch’s experiments led him to refute this hypothesis. He saw that, contrary to what Roux had observed, the splitting of an early embryo (blastula) led to the development of two *complete*, albeit smaller, embryos. This led him to conclude with what became the basis of his theory: "If I call the fate of each blastomere in the course of development its prospective value, then I can summarise my experimental results as follows: the prospective value of each blastomere is a function of its position in the whole.”[20] (Driesch 1894, p. 11-12).

2.D.1 – Equipotential Systems

In the new batch of experiments, that took place during the winter of 1894-95 (after publishing his *Analytische Theorie des organishen Entwicklung*) Driesch observed the same phenomena he had seen in his famous 1891 experiments: in these latter experiments, the sea urchin embryos, at a later stage (gastrula), were cut in half but guaranteeing that both endoderm and ectoderm (the germ-layers) were preserved in each. He observed that in both halves the wound was repaired and each part developed into a complete but smaller embryo, just as before (Allen 2008, p. 67).

Through these results he postulated that in these systems (the germ-layers in this case), their elements (cells) had the same prospective potency, that is, “each of their elements may play every single part in the totality of what will occur in the whole system” (Driesch 1908, vol 1, p. 120). He fittingly named them “Equipotential systems”. These elements have the potential to produce any part of the system and, in each case, their fate is determined by the position they occupy. (Driesch 1908 Vol. 1, p. 119-121)

However, a new observation led to a breakthrough that would feed his theoretical writings in the following years: not only did the embryos regenerate, but the normal proportions

[20] Wenn ich das Schicksal jeder Furchungszelle im Entwicklungsgange ihre prospektive Bedeutung nenne, so kann ich meine Versuchsresultate in diesem Satze zusammenfassen: Die prospektive Bedeutung jeder Blastomere ist eine Funktion ihrer Lage im Ganzen.

of the whole embryo were achieved. (Churchill 1969, p. 178; Driesch 1908 Vol. 1, p. 123). In the figure below we can see the results of this experiment.

Figure 5

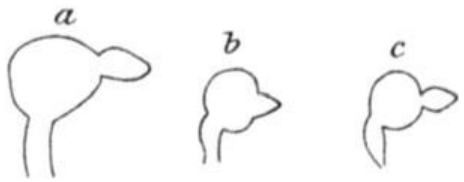


Figure 5 – *Sphaerechinus granularis* (sea urchin) digestive tube with normal development (a) compared with the relative size of two embryos cut in half at the gastrula stage (b-c) (adapted from Driesch 1899, p. 39).

In the previous experiment, the embryo had just started its development and the proportions of the whole individual were not fixed at that point. Now, at a later stage, the organs have appeared, meaning that the proportions are established. How is the embryo able to regenerate a part considering its relation to the whole individual? For Driesch, the observation that the organism is able to reconstruct the correct proportions of its body means that equipotential systems work in harmony as a whole. Is there in fact an "intelligent" guiding force, like the *Bildungstrieb*? He therefore calls these systems "Harmonious Equipotential systems": "There are indeed indefinite singular potencies at work in all of our systems during ontogeny: but the sum of what happens to arise in each case out of the sum of the single acts performed by all of the single equipotential cells is not merely a sum but a unit; that is to say, there exists a sort of harmony in every case among the real products of our systems. The term harmonious-equipotential system therefore seems to be the right one to denote them." (Driesch 1908, vol 1, p. 121)

2.D.2 – Harmonious Equipotential System

How does this system explain the processes of ontogeny? As previously described by Driesch, the development of the embryo happens through the prospective potency of each element becoming gradually realized in its prospective value. But the number of possibilities contained in the prospective potency is much higher than those that are actually seen in each step of ontogeny. The question, therefore, is: how are these two concepts related? How is the

prospective value determined? In Driesch's words: "On what factors does the fate of any element of our system depend in all possible cases of development obtainable by means of operations?" (Driesch 1908, vol 1, p. 123)

The initial investigations had shown that one of the factors that determines the fate (prospective value) of a certain element is its localization in the organism. The new experiments also showed that, after being cut, a proportionate embryo still develops, meaning that the fate of a cell also depends in some way on the absolute size of the part (tissue or organ) where it belongs. If we express these results as an equation we get: p. v. (X) = f(s, l); Meaning that the prospective value of the element X is a function of the size of the system (s) and its position (l).

However, there is still another factor to account for. According to Driesch, the size of the system and the position of the element are variable, but the fact that in every possible case the result is proportionate means that there is another, invariable, factor which accounts for this harmony between the parts. Driesch calls this factor Entelechy (E). The equation therefore becomes: p. v. (X) = f(s, l, E) (Driesch 1908, vol 1, p. 125)

As mentioned by Frederic Churchill: "With his Analytical Theory (…) Driesch appeared to his contemporaries to be steering all too close to the forbidden shoals of vitalism" (Churchill 1969, p 176). With the introduction of the Harmonious Equipotential system, and especially the concept of Entelechy, Driesch has not only reached those shoals but has actively cast his net, looking forward to a plentiful catch.

2.D.3 – Introducing Vitalism

Driesch's academic career between 1891, with his famous experiments, and 1908, with the publication of the Gifford Lectures delivered at the University of Aberdeen, is fascinating because he temporally crosses through the spectrum of positions regarding the mechanicism-vitalism discussion. Driesch, starting off following Roux's *Entwicklungsmechanik* program, hoped to bolster the descriptive and mechanical causal analysis of development with new experiments. What he found was the glaring inadequacy of answering the big questions of ontogeny exclusively with a causal analysis of its processes. Eventually, Driesch observed that the developing embryo did not behave only as a sum of its processes but as a unit, a whole. For him, this "relative proportionality" was the evidence for a new factor: Entelechy.

What does Driesch mean by Entelechy? What are its properties and its role in the development of organisms? In order to answer these questions, we need to first introduce a few concepts. This will be crucial for fully grasping the importance of Driesch's concept.

Chapter 3 – Hans Driesch and the Concept of Teleology: From Static to Dynamic

3.A – Never a Mechanicist

In the previous chapter on Driesch we saw how he started his embryological career by following Roux's "Developmental Mechanics" approach focusing on a causal analysis of development complemented with experimentation. However, when replicating Roux's experiments he did not observe the same results. Further experiments led him to consider that an explanation of natural processes exclusively based on physical and chemical laws was not sufficient. Eventually Driesch abandoned the causal analytical framework explanation and opted for a teleological understanding of development. We might thus be led to believe that Driesch started from a purely mechanistic perspective of development and later converted to a teleological one. However, this may not be exactly the case, for, during his first years of experimentation, he was already suspicious of the suitability of *Entwicklungsmechanik* for answering the bigger questions of biology. "Unsatisfied with the vague, unclear and unfounded fantasies of our modern biological research, I was initially drawn to the few attempts that call themselves exact; this led me to an analysis of these 'mechanistic' endeavours, but, at the same time, already to some doubt about their value for the real biological questions."[21] (Driesch, 1894, p. v).

This is the argument put forward by Shelley Innes. She argues that Driesch had a teleological perspective from the start: "Teleology in some form was always an integral part of Driesch's theoretical framework" (Innes 1973, p. 49). We could therefore argue that, when Driesch was replicating Roux's experiment, the observation that a sectioned early embryo leads to two normal but smaller embryos was the empirical starting point for him for evaluating the teleological component that he endorsed from the very start of his experimental work: "The theory of morphogenesis [*Formbildung*] appropriately begins with an investigation of the question of which basic means are available to create an organism from the germ. The

[21] Unbefriedigt von den unbestimmten, unklaren und unbegründeten Phantasien unserer modernen, biologischen Forschung zogen mich zunächst die wenigen Versuche an, welche sich selbst exakt nennen; das führte mich zu einer Analyse dieser »mechanischen« Bestrebungen, gleichzeitig freilich schon zu einem Zweifel an ihrem Wert für die eigentlich biologischen Fragen.

expression 'means' is teleological since every means presumes a goal..." (in Driesch 1890; quoted in Innes 1973, p. 34)

Consequently, Driesch's theoretical struggle was not between a mechanistic and a teleological interpretation of the natural processes. It was between two alternative ideas of teleology. In his publications between 1891 and 1899, Driesch tries to make sense of his experimental results while attempting to define this teleological component. "What changed in Driesch's later formulation of his theory of development was not his fundamental belief in the necessity for a teleological component in the explanation of morphogenetic processes, but rather his conception of the teleological component itself" (Innes 1973, p. 43).

In his 1893 book (*Die Biologie als selbständige Grundwissenschaft*) we can see his first attempts to specify this component, even if at the time he had not clearly identified the different hypotheses: "My work [of 1893] vacillated, without my knowledge, between the recognition of a creative principle and a natural mechanistic teleology" (Driesch 1914a, p. 176). Later in 1894 the issue persists: "In 1894 I expressed in my *Analytische Theorie der organischen Entwicklung* a thoroughly mechanical teleology in the form of different 'given' harmonising means, but here, too, I did not perceive that I was pleading for one of two rival teleological possibilities." (Driesch 1914a, p. 176).

Innes raises an important issue by mentioning that Driesch did not shift from a mechanicist perspective of development to a teleological one. This is a historically crucial issue. However, this is not the focus of this work. In this section we want to delve deeper into the second part of Innes's argument. We want to analyse Driesch's quest to choose between two alternative concepts of teleology.

3.B – Back to Life: The Fundamental Problem of Biology

In order to understand Driesch's dilemma, we need to start by looking at what he means by teleology or purpose. Driesch affirms that one can generally define purposive "such actions as experience shows to contribute directly or indirectly to a definitely desired end" (Driesch 1914a, p. 1). If we consider the purely descriptive concept of purposiveness, it can be applied to a great variety of relations (Driesch 1908 Vol. 2, p. 130).

On a first level, we can consider human actions as purposive. I can understand my own actions as purposive because I know the object of my action, my goal (Driesch 1914a, p. 1).

"All my acting towards a purpose is based upon knowledge of the means by which the purpose may be attained, and upon judgment of the suitability of those means" (Driesch 1908 Vol. 2, p. 131). From this stage it is possible, by analogy, to consider the action of another man as purposive: if someone acts in a certain way, I can place myself in his position and imagine myself acting like him.

The descriptive concept of purposiveness can be extended from human action to the organic world whenever events are shown to be leading to a certain end. In this sense, a great variety of organic processes can be called purposive (Driesch 1914a, p. 2-3). However, how can we affirm that certain processes are teleological or purposeful and others are not? In the case of higher animals, the acting analogy can be applied, since the actions of some animals can be considered intelligible to some extent (Driesch 1908 Vol. 2, p. 131). But for lower animals the analogy does not hold. Instead, what we observe is that purposiveness in the physiological and morphogenetic processes of these living beings is oriented to the formation and preservation of the organism. Such a process can be considered purposive for two additional reasons. First, by noting that the preservation of an organism is the preservation of a specific organization of simple elements (what Driesch calls a constellation – that is, a configuration of physical and chemical agents); and, secondly, by understanding that the manifestation of the process takes place in an innumerable amount and succession of individuals, which are reciprocally cause and effect to each other. (Driesch 1908 Vol. 2, p. 131; Driesch 1914a, p. 3). In short: "In fact every organic process, morphogenetic or physiological, is 'purposeful' for the reason that it serves to form and to preserve a specific constellation which occurs in indefinite exemplars, and whose specificity has no other reason than the existence of a previous specificity of the same type; for this reason and for no other is an organic process 'teleological'". (Driesch 1908 vol 2, p. 132).

According to Driesch, the concept of teleology can be expanded further, this time beyond the organic world itself. In fact, it is possible to also consider as purposive the processes of machines which, when working, can be described as contributing to an end. (Driesch 1908 Vol. 2, p. 134; Driesch 1914a, p. 3). Here the focus is on the process itself, and not the machine as such, as an artefact (using Driesch's terminology).

As a whole, a machine is ultimately purposive because "(…) it is the result of purposive action, of human action, but it is the fact that it is made *for* processes that distinguishes it from other human artefacts, from works of art for instance" (Driesch 1914a, p. 4; his emphasis).

Consequently, when focusing on the processes produced by machines we find examples of purposive events outside of the organic world: “There are, then, inorganic things, namely, those made by men, which show us processes deserving the predicate purposive.” (Driesch 1914a, p.4). However, Driesch argues that, while overall a machine is purposive due to acting, each single process is purposive due to its position in the whole. “It is clear that here the purposiveness of each single process rests on the specific order of the specific parts of a machine, and is determined by this order. In other words, each single effect in a machine is only purposive in so far as it is part of a higher specific whole; and this it is in virtue of the constitution or structure of that whole.” (Driesch 1914a, p.4).

Again, we see what Driesch means when he affirms that there is a great variety of events that can be called purposive. Already through this brief analysis we find evidence that Driesch favoured a teleological perspective of the world over a mechanicist one. Now, the main question that Driesch is trying to answer is how to understand the purposiveness of the natural processes of organisms, mainly morphogenesis. He was convinced of the teleological perspective over development, but, as mentioned above, by the time of his first theoretical publications, he was not completely aware that he was in fact arguing for two conceptions of this teleological principle.

This struggle is what he calls the “fundamental problem of biology” – the origin of teleology in the natural world: “Are those processes in the organism, which we described as purposive, perhaps only purposive in virtue of a given structure or tectonic, of a ‘machine’ in the widest sense, on the basis of which they play their part, being purposive therefore only in the sense in which processes in a machine made by men are purposive; or is there another special kind of teleology in the realm of organic life?” (Driesch 1914a, p. 4). He eventually defined them as, respectively, static and dynamic teleology. For Driesch, static teleology corresponds to a mechanical-teleological idea of development, introduced in his 1894 book and accordingly named “machine-theory” of life in 1896. Dynamic teleology on the other hand, corresponds to what Driesch means by Vitalism: “the autonomy of vital processes” (Driesch 1914a, p. 5). The struggle between these two ideas defines Driesch’s theoretical writings throughout the 1891-1899 period.

3.B.1 – Static Teleology: The Machine-Theory

Historically, the first conception of teleology that Driesch adopted is of a static sort, represented by the machine-theory of life. This idea was mostly outlined in his 1894 book and then expanded on in his 1896 paper where it got fully developed? Driesch's static teleology suggests that the purposiveness of natural processes can be exclusively determined by their position in the whole individual. In other words, if the combination of natural processes and states can be regarded as the outcome of another primarily given physico-chemical combination of a fixed character, as in machines. (Driesch 1908 Vol. 2, p. 341).

Driesch attempts to take the explanation of teleology from machines and expand it to organisms. First, as mentioned above, an organism and a machine can both ultimately be seen as a constellation, that is, as an object composed of simple elements. Additionally, we saw that in the case of machines the presence of a teleological principle does not eliminate the need for traditional causal analysis (i.e. in terms of efficient causality), and the same should be true for organisms. The explanation of the purposiveness of natural processes through static teleology does not mean the denial of cause and effect in those events (Allen 2008, p. 66). As Driesch says: "(…) we understand with absolute clearness and distinctness that a process in nature may be teleological or purposeful, and that it may be at the same time of a purely mechanical or physico-chemical order; indeed all processes going on in human-built machines are of that class, no matter what the machine" (Driesch 1908 Vol 2, p. 135)

The analogy between organism and machine is possible by observing that the physiology of a living being can be compared to the functioning of a machine. The purposiveness of a process can therefore be understood by situating it within the whole: "We know that in these cases every single process of the whole of the engine's function goes on in its singularity, and that its purposefulness or teleology is due only to its place and combination in the whole: it only is purposeful because it stands in this special relation to other single processes, and for no other reason at all." (Driesch 1908 Vol 2, p. 135). In an organism's case this means that "the cells are oriented in a certain way with respect to the whole and their differentiation is ultimately based on that orientation" (Innes 1973, p. 45).

Does this analogy hold for the development of an organism? The defining step is accepting that the finished structure of an individual is already "given" in its embryo (Driesch 1894, p. 165). That is, the structure has to appear as already "given" in the totality of the processes of

development and can only be understood as the final goal of ontogeny (Churchill 1969, p. 176; Sander 1997, p. 37).

The teleological principle is at work in this machine, meaning that the 'given' is the real domain of teleology (Innes 1973, p. 41-42). Consequently, this machine can be causally analysed: "On the basis of these given properties, of this 'machine', we understand, with the aid of physics and chemistry, its functioning causally very well, the working of the developmental not less than that of the physiological 'machine'". (Driesch 1896, p. 364; quoted in Sander 1997, p. 37).

In his 1896 paper Driesch summarizes his theory as follows: "(…) I may call my conception formally teleological or physical-chemical-tectonic-teleological, but perhaps it is better to call it machine-theory of life." (Driesch 1896, p. 365; quoted in Waisse-Priven 2009, p. 49). In short this theory simply says that "the process of life and its order is only a special case of those laws which are valid elsewhere and of the general order of the world. The constellation of all the single cosmic elements just happens to be of such a nature that we also get amongst them those processes which are grouped together as 'life'" (Driesch 1914a, p. 5). Life is only distinctive as a combination and not because of its own laws.

In the end, an issue has to be mentioned: "(…) the result of all the physico-chemical processes was ultimately coordinated and determined by a sort of machine which worked to a pre-set plan." (Innes 1973, p. 43). But where does the plan or goal that orders static teleology come from? According to Driesch, the problem has no solution, and this is an unsettling observation: "it is precisely owing to this circumstance that the life-machine does appear to be something different from technical machines whose origin we know, even if the kind of purposiveness is the same in both cases." (Driesch 1914a, p.5)

3.B.2 – From Static to Dynamic

In 1894, although not completely aware of the difference between static and dynamic teleology, Driesch was clearly arguing for one of two competing conceptions of teleology, in this case the static one (Driesch 1914a, p. 176). But the publication of his 1896 paper, although written as a defence of the machine-theory, is evidence of the emergence of a new stage in Driesch's ideas. His 1896 paper was published in order to answer to some of the attacks against his 1894 book. After the publication of *Analytical Theory*, Driesch was accused by Roux and Emil du Bois-Reymond of getting near to vitalistic theories: "with his Analytical Theory (…) Driesch

appeared to his contemporaries to be steering all too close to the forbidden shoals of vitalism" (Churchill 1969, p. 176).

In 1896, his main message is to clarify that he is not proposing a vitalistic theory, but a mechanical-teleological one, which he calls the machine-theory of life: "Thus, what I proposed was not at all 'vitalism' but was (…) exactly the *common opinion of physico-chemical dogmatism*! Only, I did not hesitate to see and pronounce the consequences of this dogmatism (…): the *givenness of the purposeful basis* on which the events of life come to pass" (Driesch 1896, p. 365, his emphases; quoted in Sander p. 36). This answer is, among others, directed at Roux, who accuses him of over-simplifying the processes of development. In response, Driesch states that, as mentioned above, the use of a teleological component to explain the processes of development does not understate the role of the causal analysis of development.

However, what is revealing of Driesch's changing position in the articulation of his teleological dilemma appears a few pages later: "In [stating] this I do not intend to defend my [earlier] opinion – the machine theory of life – as being correct; I only wanted to make clear what I did say [in 1894]; that alone is the purpose of this treatise (…) Could not the unsatisfactory aspects of this view, which leaves us with so much [teleological] 'givenness' (…) be eliminated by a really 'vital' theory?" (Driesch 1896, p. 367; in Sander 1997, p. 36). In a later work, he looks back on his 1896 paper: "According to his own words, this was a retrospective defence of an earlier view he did not hold anymore, but that he was adamant in keeping clear from any vitalistic shadow for being a variety of teleological mechanicism" (Driesch 1951, p. 100; quoted in Waisse-Priven 2009, p. 49).

In summary, his 1896 paper reveals two new aspects of Driesch theoretical musings. First, he is now aware that he is struggling between two alternative ideas of teleology. The main point of his paper is in fact to elucidate that his initial theory is the machine-theory of life, the static-teleological view (although he does not yet use these terms here), as opposed to dynamic-teleological vitalism. Second, in what could be ignored as a side note added at the end of the paper, he is opening up the possibility of a "vital theory" as a better explanation for his experimental results.

3.B.3 – Dynamic Teleology

The conclusions in his previous paper show that a shift in Driesch's position on the teleology dilemma had already taken place by 1896. Can we identify what caused this change? In a famous passage, Driesch describes how, while taking a walk in the woods in Zurich, the vitalistic hypothesis appeared to him. He says: "But where, in the mechanistic sense, was there then the cause for the fact that in a given case this element renders this result and that element that result from the contents of their own completely homogeneous potencies?" (Driesch 1951, p. 109; quoted in Churchill 1969, p. 184). So, what happened between the 1894 book and Driesch's revelation that led him to change his mind on the machine-theory of life?

The answer is already evident if we go back to the previous chapter of this work. In the winter of 1894-95 (after publishing *Analytische Theorie*), Driesch performed a new batch of experiments, to further investigate his previous results. In these experiments, he repeated his previous embryo-sectioning experiments, only now with embryos at a later stage. He observed that, as before, the parts sectioned were still able to develop into a normal but smaller embryo. However, in these new experiments, not only was regeneration taking place but, even more significantly, the proportions between the different parts of the embryo were restored.

What Driesch observes is that this result cannot be explained by just a sum of the prospective potencies of each element. As quoted above, he says: "There are indeed indefinite singular potencies at work in all of our systems during ontogeny, but the sum of what happens to arise in every case out of the sum of the single acts performed by all of the single equipotential cells is not merely a sum but a unit; that is to say, there exists a sort of harmony in every case among the real products of our systems. The term harmonious-equipotential system therefore seems to be the right one to denote them." (Driesch 1908, vol 1, p. 121). Driesch argues that there has to be some non-variable factor ordering the proportional regeneration of the part sectioned (Driesch 1908 Vol. 1, p. 124-125). Driesch publishes these results for the first time in 1899, with the book *Die Localisation morphogenetischer Vorgänge.* This publication thus marks the final step in Driesch's shift from static teleology to dynamic teleology.

This means that in order to understand Driesch's struggle between the machine-theory of life and vitalism and, later, his transition from one to the other, we need to look into how both perspectives deal with this decisive issue: how to account for the unity between the different parts of an embryo during normal development and, particularly, after a significant disturbance.

3.B.3.1 – The Case Against the Machine

Driesch's gut-regeneration experiments introduce a new factor to take into account: the proportionality of the regenerating parts. This discovery brings back the importance of the problem of the localisation of morphogenetic events.

In the machine-like understanding of development, the relative positions of the embryonic cells determine the activation of a chain of chemical stimuli and responses which lead to the production of an organ with certain proportions: "The cells are oriented in a certain way with respect to the whole and their differentiation is ultimately based on that orientation" (Innes 1973, p. 45). However, what happens when the embryo is in a more advanced stage where the proportions are already determined? We observe that not only is development restored but the proportionality between the regenerated part and the whole is also maintained. An efficient causal description does not account for this result: "the reorientation can hardly be considered an 'effect' of the arbitrary cut, at least not in the purely mechanical sense, because the same effect is produced regardless of the precise location of incision" (Innes 1973, p. 46). This means that, under the harmonious equipotential system a far more complex task is required: "Since the response of each cell was a function of its place in the whole rather than the initial cause which brought it forth, the total response was not related to the embryologist's scalpel but seemed solely coordinated to the goal of normal development. The effect was goal-directed in a much more immediate sense than the teleological organic-machine of 1894." (Churchill 1969, p. 181).

How can we therefore explain these events? The first hypothesis would be that an external influence determines the localisation of organogenesis. However, this hypothesis is quickly dismissed. Any kind of external force, even if it affected the embryo, would have no directional value, for these are usually equal throughout the embryo (Driesch 1908 Vol. 1, p. 133; Smith 1955, p. 193)

This "directional value" must come from some teleological factor. The remaining two hypotheses are, therefore, the answers to the fundamental question of biology: are the processes "the result of a special constellation of factors known already to the sciences of the inorganic, or (…) the result of an autonomy peculiar to the processes themselves"? (Driesch 1914a, p.1). That is to say, is the teleology static, "given" in a machine inside the embryo, or is it dynamic, a factor irreducible to physico-chemical laws?

According to the first hypothesis, the machine-theory of life, the development of organisms can be causally investigated if the structure of the embryo is found, "given", in the egg. Consequently, "is it not possible that there is within the structure of the embryo an organization of either a physical or chemical type – i.e., a machine in the broad sense – that precontains the organization of the complete organism, so that no real new complexity of relations has been produced at all? (Smith 1955, p. 194).

Here, we have two main possibilities. The first is to consider if there is a chemical explanation for ontogeny: "that a chemical compound of a very high degree of complication might be the very basis of both development and inheritance, and that such a chemical compound by its disintegration might direct morphogenesis" (Driesch 1908 Vol. 1, p. 134). However, the chemical hypothesis is dismissed since the differentiation of the organs cannot be completely explained by the disintegration of a chemical compound. One reason this must be so is that different parts of the body with very similar chemical compositions, such as the various bones, can have very different forms and structures in the same individual. These differences cannot be simply explained by the distribution of such a compound. (Smith 1955, p. 194; Driesch 1908 Vol. 1, p. 134-138)

We are therefore faced with the second possibility, which is the real test for the machine-theory: "Could there not be some kind of a real machine in the system, which, if once set going, would result in the differentiations that are to take place?" (Driesch 1908 Vol. 1, p. 138). Can we explain the proportional regeneration of parts of the embryo through static teleology alone?

The defining step is to clarify what is meant by a machine. Driesch provides a general definition: "A machine is a typical configuration of physical and of chemical constituents, by the acting of which a typical effect is attained. We, in fact, lay much stress upon embracing in our definition of a machine the existence of chemical constituents also" (Driesch 1908 Vol. 1, p. 138). As we saw above, since the teleological component is at work in this structure, the machine, when present in the germ, should be able to drive the normal development of organisms. The processes of development could therefore be explained by the mechanism introduced in the previous chapter (also called induction centres): in each cell, the cytoplasm acts as the intermediary between external stimuli and the nucleus, creating a differential activation of the nuclear ferments. This also means that removing parts of the system (cells, tissues or even organs) should lead to fragmental development.

The decisive test for the machine-theory comes in light of the experiments performed in the winter of 1894-95: “But we know that, at least in our harmonious-equipotential systems, quite another process occurs after parts have been taken away: the development that occurs is not fragmental but whole, only on a smaller scale. And we know, further, that this truly whole development sets in irrespective of the amount and direction of the separation.” (Driesch 1908 Vol. 1, p. 139). Can these observations be explained by some kind of machine?

Such a machine, Driesch continues to argue, would have to be split into innumerable parts and still remain wholly functional in each part. This is a major obstacle, because dividing a machine into several parts will eventually destroy it. “(…) a machine, typical with regard to the three chief dimensions of space, cannot remain itself if you remove parts of it or if you rearrange its parts at will.” (Driesch 1908 Vol. 1, p. 141). In order for it to keep on working normally, the machine would have to be totally present in every part of the embryo, no matter how small. Each fragment would include the complete machine. However, as Driesch says: “A very strange sort of machine indeed, which is the same in all its parts (…)!” (Driesch 1908 Vol. 1, p. 140). According to Driesch, such a machine is not possible, an absurdity. Some other factor must be at work at the basis of ontogeny.

Surprisingly, an embryo, despite being divided (normally during morphogenesis and artificially after sectioning) is still able to function as expected. “The source of the final organization, therefore, cannot be precontained in the embryo as a machine. For even if we supposed the embryo to be made up of four machines, this would not explain how we could divide the system almost at will and still retain its wholeness and typical organization.” (Smith 1955, p. 194).

Additionally, in the machine-theory, if the structure is given then the processes of morphogenesis take place causally. However, Driesch mentions how the regenerative response stimulated by a cut requires an instantaneous and whole-encompassing response by an embryo, and this would not be possible through any kind of mechanism: “Driesch would have had to suppose that the arbitrary act of cutting a gastrula in half caused the appropriate chemical readjustments in all the cytoplasmic filters and at the same time elicited the release of appropriate stimuli from newly located inductive centres. This was too much for the machine-theory to bear.” (Churchill 1969, p. 180-181).

All of these observations lead to the same conclusion: there can be no machine at the basis of ontogeny. Some of the crucial properties required to explain the different events of

morphogenesis are not contemplated by this explanation. This is, in short, what Driesch calls the first proof of vitalism, or the autonomy of life.

In order to strengthen his case Driesch presents two other proofs. The second proof is similar to the first one. For the second demonstration, Driesch considers what he calls complex-equipotential systems. These are systems where, unlike the harmonious-equipotential one, "every element of which is equally capable of performing the same complex morphogenetic course – the production of the whole individual." (Driesch 1908, Vol 1, p. 223). We can consider, for example, the ovary. For this proof, the starting hypothesis is the same: there must be a machine in the cell. If we trace back the development of this system, we know that, at a certain moment in development, it has its origin in a single initial cell (*Anlage*). We are therefore faced with two hypotheses: the *Anlage*, like any cell of the embryo, has inside it a machine that drives its development. However, this means that, as in the first proof, this machine has to be able to divide itself indefinitely and still remain the same, which is an impossibility. The alternative hypothesis is that there is no machine in the *Anlage*, and the machine is only established later. However, "what then constructs this machine in the definitive cells of our systems, say in the eggs? Another sort of machine perhaps? That could hardly be said to be of much use" (Driesch Vol. 1, p. 226). As before, the argument points towards the existence of a different explanation for ontogeny (Smith 1955, p. 196).

The third proof is focused on the phenomena of animal action compared to a machine. This proof is based on two criteria: the first states that the determining character of an action (if we exclude instinctiveness) is that it is learned, it becomes perfected with time. It is a behaviour pattern with a history. Additionally, unlike a machine, the action of an organism, although modified by its past stimuli, is not completely determined by them. The second criterion states that in a machine there is one response to one stimulus. Taking the example of a phonograph, it can only play what has been fed into it, and with no modifications. In an animal, however, the response may not be of the same kind as the stimuli. The stimuli received historically are broken down into elementary components and can be modified in indefinite ways. Moreover, as regards complex stimuli, the response in a machine is given by the sum of its individual components. But in an organism the single components of the response do not depend on the single components of the stimulus. For an organism, this group of stimuli is therefore not just a sum, but a whole that is different from and more than the sum of its parts. According to

Driesch, this is a further proof of the autonomy of life (Driesch 1908 Vol. 2, pp. 59-82; cf. Smith 1955, pp. 196-199)

In summary, Driesch says: "If we are going to explain what happens in our harmonious-equipotential systems the aid of causality based upon the constellation of single physical or chemical factors and events, there *must* be some such thing as a machine. Now the assumption of the existence of a machine proves to be absolutely absurd in the light of the experimental facts. *Therefore there can be neither any sort of a machine nor any sort of causality based upon constellation underlying the differentiation of harmonious-equipotential systems"* (Driesch 1908, Vol 1, p. 141; his emphasis). What is there then?

3.B.3.2 – Towards Dynamic Teleology

If we return to the start of this section, we can recall that what is at stake is the fundamental question of biology: are the natural processes identified as purposive the result of the special organization of the parts of the organism? Or is there another special kind of teleology in the realm of organic life?

What is Driesch's conclusion from the results of his latest experiments? According to him, the three proofs of vitalism show that the organism cannot be explained by static teleology alone: "we have learnt that no machine, of whatever kind and whatever degree of combination, can afford us the means of understanding what happens here in the organism." (Driesch 1908 Vol. 2, p. 136). No machine or static teleology is able to fully account for the purposiveness of the morphogenetic events.

What is the final word on static teleology? We know that there are still processes in both morphogenesis and physiology of the organism that can be explained in a physico-chemical way. Does this mean that static teleology is not entirely disproved? We find that even if we accept that some machine may be at the basis of morphogenesis, there has to be a second machine that gave rise to it, and a third one that originated the latter. Proceeding like this would be an infinitely regressing experience. Is this explanation sufficient to accept an alternative hypothesis? At this point, Driesch's proofs focus on the refutation of the machine-theory of life, rather than providing a compelling case for an alternative theory: "We had to prove exclusively by natural science that there was no possibility of a statical-teleological explanation, and this, I trust, we have succeeded in doing." (Driesch 1908 Vol. 2, p. 136). All of his three proofs of

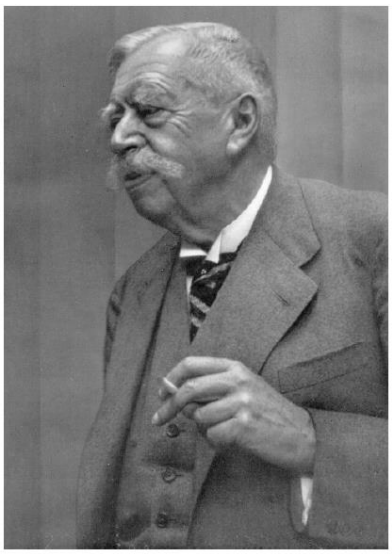
vitalism work by elimination, and as Conklin mentions: “His [Driesch’s] first and chief evidence of vitalism is that the egg and embryo cannot be regarded as a machine because it is impossible to conceive of any machine that can be fragmented in the three dimensions of space and the fragments still be capable of forming a complete machine, as was thought to be true of the egg. But this may mean no more than that the living machine is more complex than any Driesch has in mind” (Conklin 1929, p. 30). In other words: “Driesch was quite correct that numerous biological phenomena had failed to receive any mechanistic explanations. (…) the genuine problem was that Driesch was unable to show that vitalism was the only and necessary choice.” (Chen 2018, p. 9).

What is Driesch’s next step? In the end, regardless of these logical limitations, a different explanatory factor is required (Driesch 1908 Vol. 2, p. 341). In fact, says Driesch “whenever we find typical constellations of the statical-teleological class, we are forced to conclude that there must have been in some former time some autonomous intrinsic activity.” (Driesch 1908 Vol. 2, p. 342). In his second batch of experiments, where the proportionality of the gut was preserved, Driesch finds enough evidence to discard the machine-theory of life and move on to dynamic teleology, that is, vitalism: “A sufficient basis does not reveal itself which would explain the correctly proportioned three-fold arrangement of the gut of the cut larvae; that correctly proportioned segmentation points far more to a type of phenomenon which is essentially not of a mechanical but of a specific vitalistic sort.” (Driesch 1899, p. 39; quoted in Churchill 1969 p. 179). This means that the events of morphogenesis are not caused by a special constellation of the physico-chemical parts, but by a factor irreducible to life: “There was a natural factor at work, autonomic and not resulting from a combination of other agents, but elemental in itself; this factor acted teleologically: it may therefore be called a factor of dynamical teleology” (Driesch 1908 Vol. 2, p. 136). This factor is Entelechy. Ultimately Driesch summarizes the connection between the two types of teleology: “In other words, there are many processes in the organism which are of the statical-teleological type, which go on ideologically or purposefully on a fixed machine-like basis; but entelechy has created this basis, and so statical teleology has its source in dynamical teleology.” (Driesch 1908 Vol. 2, p. 151).

With these words we are left at the threshold to Driesch’s neo-vitalism. But we will deal with an analysis of Driesch’s solution later, and in particular with the concept of Entelechy. Let us

now meet the second and main player of this discussion: Jacob von Uexküll. What are the main aspects of his biological theory?

Chapter 4 – Jacob von Uexküll: *Planmässigkeit*



4.A – Biography

Jacob Johann von Uexküll was born on September 8, 1864, the fifth child of an aristocratic German Baltic family, on an estate in modern day Estonia. (Harrington 1996, p. 35). Between 1884 and 1889 von Uexküll studied zoology at the University of Dorpat (now Tartu). He specialized in the classification of marine life, a field which would follow him in his future research (Harrington 1996, p. 38). It was also at Dorpat that "he was unquestionably influenced by two strong and contrasting schools of biological thought: the emergence of Charles Darwin's theories (1809–1882) and the legacy of Karl Ernst von Baer (1792–1876)." (Buchanan 2008, p. 9). Von Uexküll also came into contact with the ideas of Johannes Müller: "Against Darwin von Baer raises Johannes Müller's theses, perhaps the last vitalist to have left his mark on German medicine. Müller's work is also very important for Uexküll to shape his biological and environmental conception." (Brentari 2015, p. 24). Despite some initial enthusiasm, von Uexküll eventually rejected the Darwinian idea of natural selection (Brentari 2015, p. 24).

After leaving the University of Dorpat, von Uexküll continued studying at the University of Heidelberg, Germany, under Wilhem Kühne (1837–1900). Here he focused on the field of muscular physiology, mostly of marine invertebrates (Buchanan 2008, p. 11).

In 1891, von Uexküll arrived at the Zoological station in Naples, which "was attended by many leading biologists and had a stimulating atmosphere, much due to the head of the station,

Professor Anton Dohrn (1840-1909)." (Kull 2001, p. 10). "Independently wealthy, Uexküll was able to divide his time between the University of Heidelberg in the summer months and Dohrn's station in Naples during the winter in pursuit of his physiological studies on octopuses, sea urchins and peanut worms." (Rieppel 2016, p. 137)

It was here that von Uexküll and Hans Driesch met. "Driesch, who was independently wealthy, decided instead to pursue a career as a private scholar—again, much like Uexküll. In 1891 he went to the zoological station in Naples to pursue marine biological research, and here he met Uexküll, who had been working on his own research at the station since the previous year." (Harrington 1996, p. 48). Von Uexküll's "thinking during these years was dominated by a tension between vitalism and mechanism, a conflict that fuelled his discussions with Driesch." (Rieppel 2016, p. 137)

"In 1902, Uexküll was denied the access to the laboratory in Heidelberg, and in 1903 (because Dohrn turned down his request for research funds at the Zoological Station) also to the one in Naples." (Brentari 2015, p. 28). Eventually, in 1907, von Uexküll received an honorary doctorate from the University of Heidelberg for his work in muscle physiology (Kull 2001, p. 10). As a consequence of the Russian October Revolution of 1917, Uexküll lost his estate and investments in Estonia, leading him to move back to Heidelberg (Rieppel 2016, p. 139). "This severely restricted Uexküll's possibility to conduct independent experimental research, and was perhaps one of the reasons that led him to devote himself more and more to theoretical works." (Brentari 2015, p. 32)

In 1920, von Uexküll finished writing his "*Theoretische Biologie*". "Though it was not immediately widely spread, *Theoretische Biologie* marked a turning point in the production of Uexküll." (Brentari 2015, p. 33). In 1926 von Uexküll founded "his Institut für *Umwelt*forschung, and in 1927/28 was promoted to full professor and director of that institute. (Rieppel 2016, p. 139).

Like Driesch, his final years are marked by the effect of the German government on his career: "With the escalating radicalization of the Nazi regime, vehemently rejected by Uexküll, and the increasing preparations for war, Uexküll's science fell into disregard and neglect. To finance the research activities at his institute proved increasingly difficult, and pressure on him to retire increased. A disillusioned Uexküll withdrew to the island Capri in 1940, where throughout the vagaries of turbulent times he had managed to maintain a villa. He died in Capri on July 24, 1944." (Rieppel 2016, p. 140).

4.B – Virtue Is in the Middle

4.B.1 – Situating Jacob von Uexküll in the Historical Debate

As mentioned, the debate over the properties of life has been taking place within a spectrum: "The discussion over the phenomenon of life hinges on whether the properties of life are considered to be just a combination of the physico-chemical laws or the result of an extra-material factor that elevates the matter to a new level of organization" (Brentari 2015, p. 48). As pointed out in the Introduction, these two opposite views are generally called mechanicism and vitalism. We saw how Hans Driesch travelled across this spectrum throughout his experimental career. He started by studying the development of organisms, following Roux's approach of "developmental mechanics", and eventually ended up as one of the most important defenders of vitalism. Now, we want to know where Jacob von Uexküll fits in this discussion. We have already seen that he usually criticizes the mechanistic position, yet he also does not identify himself as a vitalist. How can we describe his views? The study of von Uexküll's ideas is especially interesting in helping us understand the range of possibilities in the mechanism-vitalism debate.

Given that we are trying to place von Uexküll in the mechanism-vitalism discussion, the starting point should be to explore how von Uexküll accounts for the properties of life. This means looking for characteristics that can only be found in living beings and not in inorganic matter. Von Uexküll therefore starts his investigation on the frontier between organic and inorganic. More specifically, he begins by comparing organisms to their inorganic life-like counterparts: machines.

The analogy between machine and organism is especially useful when considering the processes of a fully developed organism since, as von Uexküll states: "[the normal path of the activities of life] takes place in a way that is totally similar to the working of a machine"[22] (von Uexküll 1913a, p. 126). This means that for all animals (except for some single-cell organisms) their normal life functions, like physiology, behaviour etc., can be understood in accordance with physico-chemical laws, with reference to structural factors and antecedent causes. (von

[22] Der [normale Ablauf der Lebenstätigkeiten] geschieht durchaus analog dem Arbeiten einer Maschine

Uexküll 1909, p. 31; Brentari 2015, p.71). Von Uexküll terms them the laws of general mechanics (*allgemeine Mechanik*), that is, "the law of the levers, the law of communicating tubes etc."[23] (von Uexküll 1928, p. 104). The application of the mechanical causal analysis to the different steps of ontogeny had already been described in the *Entwicklungsmechanik* method founded by Roux and initially followed by Driesch. They were also described in accordance with physico-chemical laws: "He [Roux] also assumed that the processes of development and other living functions are mechanistic and can be understand [*sic*] in mechanical terms, which conform to general rules of mechanical causation. Otherwise there could be no science at all, he felt." (Maienschein 2013, p. 56).

4.B.2 – *Bauplan*

However, while the processes of an organism and machine can, according to von Uexküll, be analysed through the laws of physics and chemistry, something more needs to be taken into account when considering the combination of all of the processes: "When the carpenter's axe chops up wood into rods and sticks, and when the drill bores through the rods and the hammer drives the sticks into the holes, what we are dealing with here are causal sequences. But the structure emerging from this process, the ladder, cannot be interpreted by causality at all; it can be understood only from the knowledge of the designed arrangement of the rungs with relation to the main rods, and of all the parts to the whole"[24] (von Uexküll 1928, p. 84).

As we mentioned in the Introduction, von Uexküll's use of "causality" only includes what is generally referred to as "mechanical causality", that is, it excludes any kind of "final causality". This is why, for von Uexküll, the mechanical analysis of an organism or machine is not dismissed but limited to describing the individual causal events. Causality only accounts for the effect of one event on the following one. It is does not account for the overall unity of these phenomena. Accordingly, it is not possible to understand the totality of a machine or an organism through the physico-chemical analysis of its parts. For both of them, the knowledge of their structure, *viz*. their building plan is required: "In this respect machines and developed

[23] (...) wie dem Hebelgesetz, dem Gesetz der kommunizierenden Röhren
[24] Wenn die Axt des Schreiners das Holz in Stangen und Stöcke spaltet, der Bohrer die Stangen durchbohrt und der Hammer die Stöcke in den Löchern sind, so sind das lauter reine Kausalreihen – das hierbei erhaltenene Gebilde, der Leiter, ist aber kausal gar nicht zu begreifen , nur nur durch Kenntnis der planvollen Beschaffung der Sprossen zu den Stangen und aller Teile zum Ganzen.

organisms are completely identical. From both, one can design an intuitive plan, with contains nothing but limbs or organs stored side by side in space."[25] (von Uexküll 1909, p. 12). The causal analysis of the processes of both machines and organisms is complemented with the interaction of the individual processes between them and the whole structure. The relationship between the parts in space is represented in their *Bauplan* (building plan).

By *Bauplan*, von Uexküll means two different things. On the one hand, as we saw above, the *Bauplan* means the spatial arrangement of the parts that compose a whole: "We can visualize this interaction of the parts in a spatial scheme for both machines and organisms. This spatial scheme is called the organizational plan (*Organisationsplan*) or the building plan (*Bauplan*). Any building plan in this sense is nothing more than a blueprint (*Grundriss*), which we draw after we have gained further knowledge of an organism or a machine. The building plan shows us in what form the processes take place within the examined object. It serves to provide nothing more than a clear description of the processes"[26] (von Uexküll 1909, p. 12).

On the other hand, as becomes clear from the previous quote, it is not only the organization of the different parts in space, but of the different processes contributing to? the total function of machines and organisms: "Both consist of individual parts that combine to form a whole. The union of the parts to the whole is in both cases not merely formal, but functional, i.e. the performances of the individual parts of a machine or an organism unite in the overall performance of the whole"[27] (von Uexküll 1909, p. 12). "(…) the individual structural parts do not just form a spatial whole like the water crystals in a snowflake, but a functional whole like the building blocks of a house."[28] (von Uexküll 1909, p. 30). Here the *Bauplan* reveals the operational plan (*Betriebsplan*) of machines and the functional plan

[25] Hierin sind sich also Maschinen und ausgebildete Organismen völlig gleich. Von beiden kann man einen anschaulichen Plan entwerfen, mit lauter im Raum nebeneinander gelagerten Gliedern oder Organen.
[26] Dieses Zusammenwirken der Teile können wir uns in einem räumlichen Schema sowohl für die Maschinen wie für die Organismen zur Anschauung bringen. Dieses räumliche Schema nennt man den Organisationsplan oder den Bauplan. Jeder Bauplan ist in diesem Sinne nichts anderes als ein Grundriß, den wir entwerfen, nachdem wir von einem Organismus oder einer Maschine nähere Kenntnis gewonnen haben.Der Bauplan zeigt uns, in welcher Form die Prozesse innerhalb des untersuchten Gegenstandes ablaufen. Er will weiter nichts als eine übersichtliche Beschreibung der Vorgänge liefern
[27] Beide bestehen aus einzelnen Teilen, die sich zu einem Ganzen zusammenfügen. Die Vereinigung der Teile zum Ganzen ist in beiden Fällen keine bloß formale, sondern eine funktionelle, d. h. die Leistungen der einzelnen Glieder einer Maschine oder eines Organismus vereinigen sich zur Gesamtleistung des Ganzen.
[28] die einzelnen Strukturteile zusammen nicht bloß ein räumliches Ganzes bilden wie die Wasserkristalle in einer Schneeflocke, sondern ein funktionelles Ganzes wie die Bausteine eines Hauses.

(*Funktionsplan*) of living beings. That is, it also accounts for the performances (*Leistungen*) of the parts in the overall functioning of the whole. (von Uexküll 1928, p. 104-105).

Additionally, while the *Bauplan strictiore sensu* represents the spatial organization of organisms and machines, the rule expresses the temporal succession: "If we want to describe the genesis of an animal, we put it in a rule that defines the temporal sequences of the individual phases. In contrast to the building plan (*Bauplan*), which gives a spatial representation of the processes, the developmental rule (*Bildungsregel*) gives a representation of the temporal succession of all processes."[29] (von Uexküll 1909, p. 12-13)

Both are connected in the sense that the rule is always subordinate to the construction plan "Uexküll makes a distinction between the building plan (*Bauplan*), which determines the spatial organisation of living beings, and the skills plan (*Leistungsplan* or *Bildungsregel*), which determines the temporal rules of these processes. The skills plan is always subordinated to the building plan" (Pobojewska 2001, p. 3). "Higher rules, which also combine temporally separate details, are generally called plans (*Pläne*)"[30] (von Uexküll 1928, p. 144).

Sciences that study living organisms, such as physiology, psychology and biology, attribute to the organism the characteristics of a machine, to different extents. However, as we just saw, a machine has to be understood as a whole and not just through an individual analysis of its parts. There is an "immaterial factor which constitutes the core (*Kern*) of all machines, whether they themselves be living or the products of living people – namely the ' building plan' (*Bauplan*)"[31] (von Uexküll 1928, p. 104). Consequently, according to von Uexküll, the structure (*Aufbau*) of a living being cannot be derived from the inorganic laws of physics and chemistry, and not even from what he calls 'general mechanics' (*allgemeinen Mechanik*): "such as the law of levers, the law of communicating tubes, etc.,"[32] (von Uexküll 1928, p. 104). There is, therefore, a 'special mechanics' (*spezielle Mechanik*) that is, "the theory of the construction of machines and mechanisms"[33] (von Uexküll 1928, p. 104). This mechanics is only possible in the context of the *Bauplan*.

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[29] Wenn wir die Entstehung eines Tieres beschreiben wollen, so fassen wir sie in eine Regel, welche die zeitlichen Folgen der einzelnen Phasen festlegt. Im Gegensatz zum *Bauplan*, der eine räumliche Darstellung der Vorgänge gibt, gibt die Bildungsregel eine Darstellung des zeitlichen Ablaufes aller Vorgänge.

[30] Höhere Regeln, die auch zeitlich getrennte Einzelheiten verbinden, bezeichnet man allgemein als Pläne

[31] (...) wenn man jenen immateriellen Faktor außer Acht läßt, der den Kern aller Maschinen, mögen sie selbst lebendig sein, oder die Erzeugnisse lebender: Menschen sein, ausmacht — nämlich den „Bauplan"

[32] (...) wie dem Hebelgesetz, dem Gesetz der kommunizierenden Röhren

[33] (...) die Lehre vom Aufbau der Maschinen und Mechanismen

4.B.3 – *Planmässigkeit* – Static Teleology?

The relationship of the parts with the whole is what von Uexküll calls "conformity with plan" (*Planmässigkeit*): "it means nothing more than that the parts are ordered in correspondence with a design or plan, in such a way that they form a whole with a functional unity"[34] (von Uexküll 1913a, p. 194). By *Planmässigkeit* von Uexküll therefore suggests that the guidance of the processes is not directed by the action of an extra-material factor. Instead there is an order in the way the processes take place, for both the edification of a house and the development of an organism. This order is simply the path that the forces take, and the shape that will be given to matter. It is not a force in itself nor a part of matter (von Uexküll 1913b, p. 40).

As we saw in a previous section of this work, this was also Driesch's dilemma: what kind of teleology is there? Is the purposiveness of natural processes exclusively determined by their position in the whole individual? Or is there an extra-material factor guiding these processes? In short, is teleology, in Driesch's terms, "static" or is it "dynamic"?

Driesch's static teleology was represented in his machine-theory of life. He said: "We know that in these cases every single process of the whole of the engine's function goes on in its singularity, and that its purposefulness or teleology is due only to its place and combination in the whole: it is only purposeful because it stands in this special relation to other single processes, and for no other reason at all" (Driesch 1908 Vol 2, p. 135). Alternatively, we find dynamic teleology, which corresponds to Driesch's vitalistic position. In this case, the tension towards a goal is provided by a special vital force beyond organisms. This force not only directs the processes of development but also the functioning of organs (von Uexküll 1913b, p. 27): "There was a natural factor at work, autonomic and not resulting from a combination of other agents, but elemental in itself; this factor acted teleologically: it may therefore be called a factor of dynamical teleology" (Driesch 1908 Vol. 2, p. 136).

We can find similarities with static teleology in von Uexküll's "conformity with plan". We could argue that *Planmässigkeit* describes a "static" type of finality: the individual parts and processes can only be fully understood in the context of the whole machine or organism. The

[34] (…) weil mit Planmäßigkeit im strengen Sinne weiter nichts gesagt ist, als daß die Teile entsprechend einem Grundrrisse oder einem Plane derart angeordnet sind, daß sie gemeinsam ein einheitlich funktionierendes Ganzes bilden.

guidance is provided by a correspondence with a plan, the organism's own plan of construction, the *Bauplan*, and not some extra-material force or energy. At this point we are reminded of our main question: is von Uexküll a vitalist, like Hans Driesch? If yes, there should also be a dynamic teleology factor which explains the spatial organization of the *Bauplan*.

We will analyse this claim later on. In this chapter we just want to introduce von Uexküll's views and establish how his ideas might interact with Driesch's views. A more detailed accounted will be offered in a later section of this work.

4.B.4 – The End of the Analogy

Up until now we have considered the conformity with plan of both machines and organisms, meaning their spatial organization and functionality according to a plan. From the start of his investigation, von Uexküll keeps the comparison in a conditional state: "It all depends on whether the life of animals can be interpreted in terms of the existence of a planned (*planmässig*) structure analogous to the structure of machines"[35] (Von Uexküll 1928, p. 96). How far does this analogy hold? The analogy between machines and organisms shows us how both kinds of processes can be understood through mechanical laws. But the understanding of the totality of processes in both machines and organism requires the notion of the whole individual and not just the sum of the individual processes. Accordingly, in the natural world, each part of an organism is directed to conform with its own plan, as each component relates to the whole individual. This means that the world picture is only complete when not only causality but also the rule of conformity with plan is considered (von Uexküll 1928, p. 84). As Buchanan puts it: "[von Uexküll] holds all of life as conforming to a plan" (Buchanan 2008, p. 4).

This is the role of biology – to understand nature as according to a plan: "Biology is looked at from the point of view of a technician that wants to test a machine. He starts by looking at the functions of the different parts of the animal's body to have an idea of the function of the whole animal. He is looking for the building plan of the living organism"[36] (von Uexküll 1913a, p. 195).

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[35] Es kommt alles darauf an, ob man das Leben der Tiere durch das Vorhandensein eines planmäßigen Gefüges analog dem der Maschinen deuten kann.

[36] Der Biologe stellt sich auf den Standpunkt eines Technikers, der eine Maschine prüfen will. Er versucht, einen Einblick in die Leistungen der Einzelteile des Tierkörpers zu gewinnen, um einen Überblick über die Gesamtleistung des ganzen Tieres zu erhalten. Er sucht nach dem Bauplan der lebenden Organismen.

Curiously we can already find a similar view if we go back to Aristotle, as pointed out by Delbrück: "Just so one should approach the study of any animal with reverence, in the certainty that any of them are natural and beautiful. I say 'beautiful' because in the works of nature and precisely in them there is always a plan and nothing accidental. The full realization of the plan, however, that for which a thing exists and towards which it has developed, is its essential beauty. Also one should have it clearly in mind that one is not studying an organ or a vessel for its own sake but for the sake of the functional whole. One deals with a house, not with bricks, loam or wood. Thus the natural scientist deals with the functional whole, not with its parts, which as separate entities have no existence" (*De partibus animalium* (I, 5; 644b21-645a37); in Delbrück 1971, p. 52)

But here is where the analogy between a machine and an organism starts breaking down, for we know that, although both are similar, there are in fact considerable differences between them: ultimately, a machine is not a living being. While their working is similar, the construction of a machine is very different from the development of an organism: "the difficulties that the problem of life presents to our reasoning do not reside in any way in the normal path of the activities of life. It takes place in a way that is totally similar to the working of a machine. The enigma is in the production of the structure"[37] (von Uexküll 1913a, p. 126).

What differences do we find in the origins of machines and organisms?

We just mentioned that, according to von Uexküll, at the basis of the construction of both machines and organisms there is the *Bauplan*. However, while these plans are analogous, the execution and consequently the emergence of each plan is very different: machines are built centripetally, the different parts joined together, while organisms are formed centrifugally, from the germ outwards. In other words, in the construction of a machine, "the individual parts of the clock, such as the hands, springs and gears, must always be made first, then placed in a common case"[38] (von Uexküll 1956, p. 118-119). In an organism, however, we find the property of development, or morphogenesis: from the original cell, a gastrula is formed and progressively all of the organs appear in a self-regulated way (von Uexküll 1956, p. 119). Buchanan sums it up: "material, nonliving things are created from the outside by

[37] Die Schwierigkeiten, die das Lebensproblem dem Verstande bietet, liegen gar nicht im normalen Ablauf der Lebenstätigkeiten. Der geschieht durchaus analog dem Arbeiten einer Maschine. Das Rätsel liegt in der Entstehung einer Struktur.

[38] (...) die einzelnen Teile der Uhr, wie Zeiger, Feder und Räder müssen immer erst fertiggestellt werden, um dann einem gemeinsamen Mittelstück angesetzt zu werden

parts being put together or taken apart, whereas living, organic beings develop from an inner force that unfolds according to a morphological plan." (Buchanan 2008, p. 14).

Not only is their mechanism of construction different, but also their design. A machine is built up by its human creator. The finality or plan of this machine is envisioned by its creator, and it is only due to this design that a machine is referred to as in conformity with some end or plan (von Uexküll 1913b, p. 114-115). In other words, a machine is structured according to an external end. An organism, however, is not built by the action of some creator, and this agent cannot be the animal itself. Both these hypotheses raise serious issues. The first alternative suggests that there is a planning agent outside of the animal, which would mean going beyond the realm of biology. The second one means that either the animal is a conscious planner, or that it is able to perceive its plan (which could not happen for example, in an embryo, where there is not yet any perception) (Weiss 1948, p. 55). Accordingly, for von Uexküll "the basic phenomenon of living nature is a plan, inherent in the animal, but not known to it nor perceived by it." (Weiss 1948, p. 55).

Here we find the limit to this analogy between a machine and organism. It appears that in organisms we find properties that we cannot find in machines. These characteristics can thus be correctly called *super-mechanical properties*. The most evident one, which we just introduced, is the property of morphogenesis.

It should be noted that at this point we are no longer talking of *Bauplan* and *Planmässigkeit* as merely neutral concepts. With machines, we talk of Plan and Rules as descriptive ways to express their working. But with organisms we already have evidence that the Plan and Rules provide some degree of autonomy. This means that they are not just descriptive but active factors[39]. "In all cells, the activities are linked to a common function by a rule. This rule transforms the cell into an independent centre that leads an independent existence. Every cell has its own in-built law (*Eigengesetzlichkeit*), and is therefore an autonomous entity (*Autonom*), because its own in-built law is part of the nature of an autonomous entity. And herein lies the difference vis-à-vis all machines; these too have a rule that turns their activity into a function; however, it is never a subjective one, but rather instilled into the machine from the outside. And

[39] In the context of this work, by descriptive factors it is meant that the plans and rules are merely terms used to characterize the organization of both machines and organisms, describing their structure and processes. They do not exert any influence on their organization. By active factors, however, it is meant that, besides describing the events of the machines and organisms, both the plans and rules have in some way a direct influence in those events.

this is why machines are never autonomous."[40] (von Uexküll 1928, p. 168). With this distinction we have a glimpse into the mystery of life: "Living matter must therefore behave quite differently from dead matter, even when they both display the same framework" (von Uexküll 1926, p. 223-224).

4.B.5 – Mechanicism

The discovery of the super-mechanical properties allows to say that "without doing violence to both concepts one can address the machines as imperfect organisms, because all the basic characteristics of the machine are found in the organisms"[41] (von Uexküll 1909, p. 11). This means that an organism cannot be reduced to the working of a machine.

In the Introduction we sketched the reductionist view, as it can be found as part of the materialist or (since the seventeenth century) mechanist position (Brentari 2015, p. 48). This view claims that both the functioning and development of organisms can be explained exclusively through mechanical law, that is, through mechanical causality (von Uexküll 1913, p. 27). Von Uexküll refers to this discussion by exemplifying how the field of biology has been often reduced to that of physiology: "The question concerning the conformity with plan is the business of biology; the question concerning the mechanical running belongs to physiology"[42] (von Uexküll 1928, p. 99). Evidently, von Uexküll strongly opposes this reductionist view: "There is only dead matter and forces! This is a statement that a biologist who has studied the development of animals cannot accept"[43] (von Uexküll 1913a, p. 253). Physiology is **"**purely mechanistic and therefore missing the basic character of a true biology, whose concepts and methods of investigation must be directed by a grasp of the central life-phenomenon, the plan" (Weiss 1948, p. 48). Additionally, von Uexküll states: "If the very existence of an object built in conformity with plan is out of the reach for the physical understanding of the world, how

[40] In allen Zellen sind die Tätigkeiten durch eine Regel zu einer gemeinsamen Funktion verbunden. Diese Regel verwandelt die Zelle in ein selbständiges Zentrum, das eine selbständige Existenz führt. Jede Zelle besitzt ihre Eigengesetzlichkeit, sie ist daher ein Autonom, denn die Eigengesetzlichkeit gehört zum Wesen des Autonomes. Darin liegt der Unterschied zu allen Maschinen; auch diese besitzen eine Regel, die ihre Tätigkeit in eine Funktion verwandelt. Diese Regel ist aber niemals eine subjektive, sondern ist von außen her der Maschine eingeflößt. Daher sind die Maschinen niemals autonom.

[41] Man wird, ohne beiden Begriffen Gewalt anzutun, die Maschinen als unvollkommene Organismen ansprechen können, weil alle prinzipiellen Eigenschaften der Maschine sich bei den Organismen wiederfinden.

[42] Die Frage nach der Planmäßigkeit beschäftigt die Biologie die Frage nach der Zwangläufigkeit die Physiologie.

[43] Es gibt nur tote Stoffe und Kräfte! Dieses ist die Behauptung, die der Biologe, der die individuelle Entwicklung der Tiere studiert hat, nicht hingehen lassen darf.

further from its horizon is the origin according with plan of an object in conformity with plan!"[44] (von Uexküll 1913a, p. 219).

So, ultimately, the role of biology is not limited to the domain of mechanical causality, and the organism is not reducible to a mechanical apparatus: "(…) all of the organism is a production in which the different parts are united according to a permanent plan, and not that it represents an amorphous and fermenting pile of elements that only obeys the physical and chemical laws"[45] (von Uexküll 1913a, p. 19). The mechanistic interpretation of living nature has to be replaced by the investigation of the super-mechanical phenomenon of the *Bauplan* (Weiss 1948, p. 48).

4.B.6 – Summary

Overall, von Uexküll's position appears to be an intermediate one, neither vitalism nor mechanicism. On the one hand, he considers that the mechanist approach is valid for most animal behaviour and physiology. The functioning of organs can be understood as analogous to the functioning of machines. On the other hand, he stresses how these processes can only be fully understood within a teleological framework. More specifically, the construction of these organs happens in conformity to a plan (*Bauplan*). However, he distances himself from the vitalistic concepts, such as a vital force or energy, or for that matter Driesch's Entelechy. The inclusion of these two aspects describes the position that von Uexküll names the "machinalist" one (von Uexküll 1913b, p. 27).

This separation between the teleological and the mechanical aspects does not mean that the teleological component is restricted to the theoretical analysis of organisms. Both perspectives should be included in an empirical investigation. In fact, in fields such as embryology, the phenomena under analysis can only be explained in a teleological context (Brentari 2015, p. 62-63). In summary: "Biology could not be fully suppressed by physiological chemistry, because even the most hardened chemist has to admit that every living being is not just something mechanical, but at the very least a machine; it cannot be just something

[44] Ist schon die Existenz eines planmäßig gebauten Gegenstandes der physikalischen Weltbetrachtung unerreichbar, um wieviel weiter liegt die planmäßige Entstehung eines planmäßigen Gegenstandes jenseits ihres Horizontes.

[45] (…) daß jeder Organismus ein Gebilde ist, in dem sich die einzelnen Teile nach einem festen Plane zusammenfinden, und das nicht einen planos gärenden Stoffhaufen darstellt, der nur physikalischen und chemischen gesetzen gehorcht.

structured, it must have a structure in conformity with plan – it is not just something organic, but an organism."[46] (von Uexküll 1905, p. 4). How does von Uexküll describe his biological theory?

4.C – *Planmässigkeit*: *Bauplan* in action

In the previous section we saw that through the perspective of physiology we could understand the evident mechanical properties of organisms. Additionally, there was a match between machines and fully formed organisms in a more fundamental aspect. We saw that both are organized in "conformity to a plan", but not just as a spatial plan but also as a functional one: "the performances of the individual parts of a machine or an organism unite in the overall performance of the whole."[47] (von Uexküll 1909, p. 12). But with the breakdown of the analogy between machines and organisms we glimpsed a new set of characteristics provided by the *Bauplan*, which are exclusive to organisms: super-mechanical properties. And so, we have touched on von Uexküll's essential enterprise: "If by biology we understand the doctrine of conformity with plan in the world of living things, we shall realise that one of the fundamental inquiries of the science [sic] must be into the nature of this conformity" (von Uexküll 1926, p. 270). Intrinsically connected to this challenge is also the understanding of the nature of the *Bauplan*. Is the *Bauplan* "merely a creation by uncritical analogy with our human life, perhaps incapable of sustaining objective consideration, which sees nothing but causality in all natural phenomena?" (von Uexküll 1926, p. 270). The discovery of super-mechanical properties suggests that the *Bauplan* could be something more than just the spatial and functional organization of different elements. So, what exactly is the *Bauplan*? Is it a true factor of nature?

We are not yet in a position to provide a satisfying answer to these questions. They are decisive for unlocking von Uexküll's biological theory, and they will accompany us throughout the rest of this work. But we can look at how the *Bauplan* operates. We can analyse how the

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[46] In der physiologischen Chemie konnte die Biologie nicht völlig unterdrückt werden weil selbst der eingefleischteste Chemiker zugeben muss, dass alles Lebendige – nicht bloss etwas Maschinelles, sondern zum wenigsten eine Maschine ist – nicht bloss etwas Strukturiertes sein kann, sondern eine planmässige Struktur besitzen muss – nicht bloss etwas Organiches, sondern ein Organismus ist.

[47] (...) die Leistungen der einzelnen Glieder einer Maschine oder eines Organismus vereinigen sich zur Gesamtleistung des Ganzen.

Bauplan is expressed in organisms and how it directs all events in the lives of organisms: how all phenomena are, as von Uexküll puts it, in "conformity with plan".

Before we continue with our analysis, it is important to introduce a set of new concepts, without which the understanding of the *Bauplan* is incomplete and preliminary. These will be crucial for comparing the different properties of machines and organisms. On a first level of understanding, reality is composed of what von Uexküll terms "things" (*Dinge*), characterized by their properties: matter in repose, organized in space. On a second level, cause and effect are considered, and we find what he terms "objects" (*Objekte*). Like "things", "objects" have properties but, additionally, they are ruled by the law of causality (and thus time is also included). Without this law, "we should only experience unwinding series of perpetually altered things"[48] (von Uexküll 1928, p. 80). There would be no unity. Each moment would be cut off from the previous moment and also from the following moment. "(…) we only ever see things in front of us that are cut off as if with a knife from the previous and the following moment."[49] (von Uexküll 1928, p. 80).

The law of causality connects these isolated moments: "things" appear to be expanded in time. Now, besides *properties*, we find *capacities*, which appear as new or altered features of "things", when they become "objects". This change is produced by the law of cause and effect: "The fixed relations that altered properties bear to the same unity are created by the rule of causality, which makes the alteration appear as the necessary effect of the external causes"[50] (von Uexküll 1928, p. 80). Now, matter is not only expanded in space but also in time, and a higher unit than the "thing" is revealed: what might be termed the "type 1 object" (*Objekt*). The spatial arrangement of objects is provided only by the structure (*Struktur*) of the substance that composes them. All inorganic matter consists of objects governed only by causality (von Uexküll 1928, p. 84).

Yet, the law of conformity with plan is not detected through the laws of physics. It has to do with a higher level of organization, where the parts stand in relation to a whole. (von Uexküll 1928, p. 84). "When the hammer strikes the string of a piano and a note sounds, that is a purely causal series. If this note belongs to a melody, it is interpolated in a sound-series, which

[48] (...) sondern würden ablaufende Reihen von stets geänderten Dingen erleben.
[49] (...) immer nur Dinge vor uns, die von dem vorhergehenden und vom folgenden Moment wie mit dem Messer abgeschnitten sind.
[50] Die festen Beziehungen der veränderten Eigenschaften zu der gleichen Einheit werden durch die Kausalitätsregel geschaffen, die die Veränderung als notwendige Wirkung fremder Ursachen erscheinen läßt.

also exhibits arrangement, but not of a causal kind"[51] (von Uexküll 1928, p. 84). Ultimately, "(…) biology asserts that besides causality there is a second subjective rule according to which we order objects in conformity with plan, which is necessary for the completeness of the worldview." [52] (von Uexküll 1928, p. 84). Consequently, there is a third level, namely the "type 2 object" (*Gegenstände*)[53]. Both type 1 and type 2 objects consist of matter and, from the outside, they appear indistinguishable from one another. But "in a [type 1] object there is no arrangement of the material parts other than that which the structure of the substance brings to it"[54] (von Uexküll 1928, p. 84). Whereas in type 2 objects the law of conformity with plan shows how their parts are connected into a whole expressing a plan (von Uexküll 1928, p. 84). This organization is the framework (*Gefüge*) of the type 2 object, which represents the *Bauplan*.[55]

4.C.1 – The Framework (*Gefüge*)

In order to understand the role of the *Bauplan* in organisms, we can start by analysing how it first appears. The main challenge is that no matter how well we know the functional plan expressed in the *Bauplan*, it provides us no evidence of how the framework (*Gefüge*) of the *Bauplan* itself was created. How is the framework built in conformity with plan? What rule guides the formation of the functional plan itself? This indicates that besides the functional

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[51] Wenn das Hämmerchen eine Klaviersaite trifft und ein Ton erklingt, so ist das eine reine Kausalreihe. Wenn dieser Ton aber einer Melodie angehört, so ist er in eine Tonreihe hineingestellt, die gleichfalls eine Ordnung darstellt, die aber nicht kausaler Natur ist

[52] (...) hierzu behauptet die Biologie, daß es außer der Kausalität noch eine zweite subjektive Regel gibt, nach der wir die Gegenstände ordnen die Planmäßigkeit, die notwendig zur Vollständigkeit des Weltbildes hinzugehört.

[53] In English versions *Objekt* is always translated as "object". However, *Gegenstand* has been translated as both implement, in the 1926 English translation of the *Theoretische Biologi*e, or as neutral object, by other authors. *Objekt* is Germanized Latin (*objectum*) and *Gegenstand* is one of the 18th Century attempts to find a German equivalent for this very same Latin word (ob-jectum: Gegen-stand). It should also be noted a) that in German there is no obvious and generally valid semantic difference between *Objekt* and *Gegenstand*, let alone b) the kind of semantic difference von Uexküll is trying to convey. What we are dealing with here is his idiosyncratic use of these two words. Von Uexküll distinguishes between *Objekte*, which are ruled only by the law of causality, and *Gegenständ*e where the law of conformity with plan is introduced. As a result, and since English does not have two different words for "object", we believe that an "idiolect translation" – viz. an obviously "terminological" translation – does more justice to von Uexküll's terminology. We therefore prefer to speak of "type 1 object" (*Objekt*) as opposed to "type 2 object" (*Gegenstand*).

[54] (…) aber im Objekt gibt es keine andere Anordnung der Stoffteile, als sie die Struktur des Stoffes mit sich bringt.

[55] By *Gefüge*, von Uexküll is referring to the existence of some kind of multiplicity (as in both *Objekte* and *Gegenstände*) and also pointing to the existence of some adjustment between the different parts. With *Bauplan*, in this sense, von Uexküll refers to the organizing principle, the unity that goes through such an organized entity.

plan, the rule of function, there has to be a *separate rule*, a rule directing the *genesis* of organisms. We can detect the same problem in the case of machines. When we look at the manufacture of a human appliance and compare it with the functioning of the final machine, we realize that the processes are very different: "undoubtedly both are guided by a rule, but the two rules cannot be identical"[56] (von Uexküll 1928, p. 146).

Previously we saw how in the case of machines we know that this rule of genesis is determined by their creator. An inventor draws up the plan of a machine and builds it in conformity with that plan. He adds the parts together, from the outside in, that is, centripetally. Organisms, however, are built centrifugally, outwards from their germ. There is no external agency. "All implements [type 2 objects] are made by a constructor situated outside, whereas all organisms arise from a germ set in a fixed position in space, a germ which has an immovable place within the structures arising out of it. All implements [type 2 objects] are made by external agents; all organisms arise from their own germ."[57] (von Uexküll 1928, p. 153). Consequently, while the functional plans of machines and organisms are comparable, the origin of these plans is very different. While the origin of machines is evident, the origin of organisms remains a mystery.

So, this is our main question at this point. More specifically, we want to know how the *Bauplan* is expressed, that is, how a framework in conformity with plan is produced by organisms.

4.C.2 – The Protoplasm Problem

As mentioned before, we are faced with a super-mechanical property, in other words we are dealing with a characteristic present in organisms but not in machines, one that goes beyond the domain of physico-chemical laws. The key to understanding this super-mechanical property is therefore to look into the differences between living beings and machines.

According to von Uexküll, the decisive aspect is that living beings, unlike machines, are composed of cells, which in turn consist of a protoplasmic cell-body and a nucleus (von

[56] Zweifellos werden beide Vorgänge von einer Regel geleitet, aber diese Regeln können nicht identisch

[57] (...) alle Gegenstände werden von einem außenstehenden Erbauer hergestellt — alle Lebewesen entstehen aus einem räumlich festgelegten Keim, der einen unverrückbaren Platz innerhalb der aus ihm entstehenden Bildungen inne hat. Alle Gegenstände werden von Außenstehenden gemacht, alle Lebewesen entstehen aus dem eigenen Keim.

Uexküll 1928, p. 168). The nucleus contains the chromosomes, that is, the genes of that cell, while the protoplasm is like a foam, the "undifferentiated matrix of the germ"[58] (von Uexküll 1909, p. 13). It consists of "fluid partitions enclosing cavities filled with another fluid"[59] (von Uexküll 1928, p. 168). Every cell of an organism contains protoplasm, so that the latter is present at all stages of its life, from its first cell all the way to the fully formed individual: "Protoplasm or the living substance is not only the starting stage of all animal and plant cells, because everything living arises from the simple protoplasmic germ. It is also found in almost all cells of an adult animal body, albeit in small amounts. In addition, protoplasm is preserved as a body substance in unicellular animals throughout their life."[60] (von Uexküll 1909, p. 13). Protoplasm should therefore form the starting point for all theories about organisms (von Uexküll 1909, p. 30).

As we saw above, both machines and organisms possess a framework (*Gefüge*) that accounts for their mechanical characteristics. But, while machines have nothing more than this framework, organisms consist of a framework plus protoplasm, which results in their super-mechanical properties: "The anatomically demonstrable existence of protoplasm permits us to assume a fundamental division between the mechanical framework and the protoplasmic net that traverses the entire body, and to ascribe to the latter all the super-mechanical powers"[61] (von Uexküll 1928, p. 97). In protoplasm we therefore find the exclusive characteristic of organisms that makes the expression of a super-mechanical property possible. This is further underlined when von Uexküll points out that "an organism without its protoplasm represents an ideal machine"[62] (von Uexküll 1928, p. 97). That is, without protoplasm an organism becomes an independent machine, where its actions are automatic and unalterable. But here lies the decisive issue: "(…) it is here that we see demonstrated the most essential contrast between what is living and what is dead. If, in virtue of its framework, a creature behaved physiologically like a living organism, but nevertheless was without protoplasm, we should be obliged to

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[58] „die undifferenzierte Grundsubstanz des Keimes"

[59] einem Gebilde, das aus flüssigen Wänden besteht, welche Kammern umschließen, die ihrerseits mit einer anderen Flüssigkeit gefüllt sind.

[60] Das Protoplasma oder die lebendige Substanz ist nicht allein das Ausgangsstadium aller tierischen und pflanzlichen Zellen, denn alles Lebende entsteht aus dem einfachen Protoplasmakeim. Es erhält sich auch in fast allen Zellen des erwachsenen Tierkörpers, wenn auch in kleinen Mengen. Außerdem erhält sich das Protoplasma als Körpersubstanz bei den einzelligen Tieren während ihres ganzen Lebens.

[61] Die anatomisch nachweisbare Existenz des Protoplasmas gestattet uns, eine prinzipielle Teilung zwischen dem maschinellen Gefüge und dem protoplasmatischen Netz, das den ganzen Körper durchzieht, vorzunehmen und alle übermaschinellen Fähigkeiten dem Protoplasma zuzuschreiben.

[62] Ist dies geschehen, so sehen wir, daß in der Tat ein vom Protoplasma befreites Lebewesen eine ideale Maschine darstellt.

describe it as dead"[63] (von Uexküll 1928, p. 97). So, the question is: what is it in protoplasm that explains the existence of these properties exclusive to organisms?

In order to understand how protoplasm works, we can look at organisms that are composed only, or at least mostly, of protoplasm (i.e. with no permanent framework). These are the unicellular animals, such as amoebae and paramecia. But before we can dive into this analysis, we must deal with a crucial problem. As we have seen, the functions of a fully formed organism can be compared with those of a machine. Consequently, a functioning amoeba should also be analogous to a machine. However, this raises an issue: how are these animals, despite being nothing more than a lump of liquid protoplasm, able to move, interact with the environment and feed themselves like all other organisms, which are analogous to machines? (von Uexküll 1909 p. 13). This is what von Uexküll calls the protoplasm problem: "here came the great fundamental difficulty that played such a fatal role in the 80 years of the history of protoplasm. The difficulty that can be most succinctly expressed in the words: Can there be liquid machines?"[64] (von Uexküll 1909, p. 14). Accordingly, "the protoplasmic problem coincides with the problem of super-mechanical capabilities in living beings"[65] (von Uexküll 1909, p. 26).

What is there in the life of unicellular organisms that can help us solve this difficulty? Just like all other organisms, amoebae still need specific organs to carry out their vital processes. We find that in unicellular organisms the organs are not formed permanently, as in higher, multicellular, organisms, but they are rather formed for each situation and (on an *ad hoc* basis) immediately dissolved: "Protoplasm achieves the most astonishing thing when it conjures up organs that are completely differentiated, created only for a narrowly defined role, and then immediately merge into the formless body mass"[66] (von Uexküll 1909, p. 22). The required organ is produced in succession, following the needs of the organism: "Their interior still consists of fluid protoplasm, and this forms around each particle of ingested food a vacuole,

[63] (...) und hierin ist dann auch der innerste Widerspruch zwischen Lebenden und Toten aufgezeigt. Wir müßten ein Wesen, das noch, dank seinem Gefüge, alle physiologischen Äußerungen eines Lebewesens zeigte, das aber kein Protoplasma besäße, dennoch als tot bezeichnen

[64] Hier trat nun die große prinzipielle Schwierigkeit ein, die in den 80 Jahren der Geschichte des Protoplasmas eine so verhängnisvolle Rolle gespielt hat. Die Schwierigkeit, die sich am prägnantesten in die Worte fassen läßt : Kann es flüssige Maschinen geben?

[65] Es fällt demnach das Protoplasmaproblem mit dem Problem der übermaschinellen Fähigkeiten bei den Lebewesen zusammen.

[66] Das Erstaunlichste leistet das Protoplasma, wenn es Organe hervorzaubert, die völlig differenziert, nur zu einem eng umgrenzten Beruf geschaffen sind und gleich darauf in die formlose Körpermasse wieder aufgehen.

which first becomes the mouth, then the stomach, then the intestine, and finally the anus"[67] (von Uexküll 1928, p. 98). These organs therefore exist only as a capacity in the protoplasm and they are produced in a certain succession when required (von Uexküll 1913b, p. 149).

From these observations it is possible to conclude two things: "first, that in order to carry out a mechanical action, a mechanical apparatus must be present"[68] (von Uexküll 1928, p. 98). As we saw, paramecia are able to produce the required organs in succession. Consequently, as each organ is formed, the machine analogy is temporarily valid, as if in a fully formed multicellular organism. The functioning of these organs, no matter how short-lived, can be understood as working by the laws of physics and chemistry. The description of the protoplasm problem indicated that there could not be a functioning machine in an exclusively liquid organism. These observations have shown that there is one, although it is a provisional machine. The protoplasm problem is therefore revised. "It is not at all a question of how the functioning of a liquid machine – such as a machine operation without a machine – is possible, since the performances [*Leistungen*] of amoebae are all exercised by organs. There is always a suitable machine available at the moment of the mechanical action, which can be very differentiated."[69] (von Uexküll 1909, p. 22-23). The question is not if such a machine exists and how it functions, but how it comes to exist.

The issue is reinforced by a second observation: "protoplasm has the power to go on creating the mechanical apparatus anew and to break it up again"[70] (von Uexküll 1928, p. 98). Here the analysis of unicellular organisms shows us how the framework is built by the action of protoplasm. In unicellular organisms, a temporary machine is produced which works according to physico-chemical laws. In multicellular animals, the organ produced is permanent. We can therefore postulate that the same pathway describes the genesis of organs in both lower and higher animals.

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[67] Das Innere dieser Tiere besteht noch aus flüssigem Protoplasma, und dieses bildet um jeden Bissen herum eine Blase, die erst Mund, dann Magen, dann Darm und schließlich After wird.
[68] Erstens, daß, um eine maschinelle Leistung zu vollführen, ein maschineller Apparat vorhanden sein muß (...)
[69] Es handelt sich gar nicht um die Frage, wie das Funktionieren einer flüssigen Maschine — wie eine maschinelle Tätigkeit ohne Maschine möglich sei, denn die Leistungen der Amöben werden alle durch Organe ausgeübt. Es ist im Moment des maschinellen Handelns auch stets eine passende Maschine vorhanden, die sehr differenziert sein kann.
[70] (...) das Protoplasma die Fähigkeit besitzt, die maschinellen Apparate immer wieder neu zu schaffen und wieder aufzulösen.

Von Uexküll's argues that all natural processes, especially morphogenesis, take place in conformity with plan (*Planmässigkeit*). As we saw, with *Planmässigkeit*, the order of the processes is provided by the organization of the whole. The guiding of the processes is not therefore directed by the action of an extra-material factor but by the *Bauplan*. The defining question can therefore be formulated: How are organisms able to produce an adequate machine by themselves, without the action of an extra-material agent?

4.C.3 – Theory of Factors

The answer to this question requires that we first exclude any physico-chemical explanations for the developmental steps. If morphogenesis is shown to be dependent only on the laws of causality, then we have no reason to look for the influence of the conformity with plan in protoplasm. One possible mechanical explanation is the mosaic theory. According to this theory we can understand the organism as a mosaic of cells. It argues that the framework of the organism (macro-mosaic) is already present, hidden in the germ: "(…) we put a hidden framework even into the germ of the organism, because the germ always allows a mechanism to proceed from it"[71] (von Uexküll 1928, p. 155). This hidden framework in the germ could have the form of a micro-mosaic, with the same properties as the final mosaic, and from which that mosaic would emerge through the laws of causality (von Uexküll 1928, p. 156). However, according to von Uexküll, Driesch's experiments refuted this hypothesis, adding that such a micro-mosaic would also be much more complicated for animals when compared to machines. Consequently: "In germ-cells there is no micro-framework which could gradually spread itself over the building-stones [cells] as they increased in number"[72] (von Uexküll 1928, p. 156).

But what if instead of a mechanical framework, there was a chemical framework? The same objection would be raised against it. It is true that the ferments present in each cell could connect the processes of development through a chemical pathway. However, at the end of morphogenesis each cell is connected in conformity with plan not only with the cells around it, but with all of the cells of the body, "and this again presupposes some hidden framework in the

[71] (...) verlegt man auch in den Keim der Lebewesen ein Geheimgefüge, weil der Keim stets einen Mechanismus aus sich hervorgehen läßt.
[72] Es gibt kein Mikrogefüge in den Keimzellen, das sich allmählich auf die immer zahlreicher werdenden Bausteine ausdehnen könnte.

ferments that give the impetus" (von Uexküll 1926, p. 194). A chemical framework does not differ from a mechanical one. "The conclusiveness of Driesch's experiments is as much against the hypothesis of a chemical as of a mechanical framework. Whether we are faced with a mosaic held together chemically or mechanically does not matter – the objections to the mosaic theory remain the same"[73] (von Uexküll 1928, p. 158).

As mentioned above, in the construction of any machine, the several independent processes are linked together in conformity with plan. So far we have seen that *Planmässigkeit* refers to "the rule that we form with the aid of our apperception when we consider the working of some particular framework (be it a living being or a machine)" (von Uexküll 1926, p. 235). We saw that, in the context of the whole embryo, the different processes themselves are mechanical, explained by physico-chemical laws. Now we want to look at the ties between them. Is there any sort of chemical or mechanical connection? "Does the manufacture of a type 2 object take place according to a materially existing template, or does it occur merely in accordance with a plan following a given rule?"[74] (von Uexküll 1928, p. 159).

According to von Uexküll, the answer rests on looking at the action of the human builder. The construction of the machines takes place through the mechanical action of the limbs of the constructor. And the action is guided by what von Uexküll calls the *impulse-sequence*. Von Uexküll's answer is based on his analysis of the directional aspect in human action. Directional information (or Direction-signs) can be both external (e.g sensory, followed by reception) and internal (sensory-motor, accompanied by an action) (von Uexküll 1926, p. 6). Von Uexküll attempts to demonstrate that sensations in the joints and ligaments of the different parts of body have no directional information. He exemplifies how the sense of touch can be easily tricked. In a similar way, the directional value is also not completely determined through muscular sensations (von Uexküll 1926, p. 11- 12).

Instead, the directional information is provided by the nerve impulse that initiates the movement (von Uexküll 1926, p. 12). These can be single impulses for the performance of simple muscular contractions, or impulse-sequences. In the latter case, "the innervation that initiates the movement consists of separate impulses which follow one another *in time*" (von Uexküll 1926, p. 13, his emphasis). What really does therefore call forth the action? Von

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[73] Die Beweiskraft der Experimente Drieschs wendet sich daher mit der gleichen Schärfe gegen ein chemisches wie ein mechanisches Gefüge. Ob wir ein auf chemischem oder mechanischem Wege zusammengehaltenes Mosaik vor uns haben, ist ganz gleichgültig — die Einwände gegen die Mosaiktheorie bleiben die gleichen.

[74] Geschieht die Verfertigung eines Gegenstandes zwangläufig nach einer materiell vorliegenden Schablone, oder geschieht sie bloß planmäßig nach einer bestimmten Regel?

Uexküll states that it was something which he calls the "will" but which we do not know (von Uexküll 1926, p. 360). Von Uexküll affirms this concerning human action, and consequently for the action of building a machine. However, how does the understanding of the building of a machine help us with the development of living beings? Is there such a guiding element in the morphogenesis of organisms? This is the hypothesis that von Uexküll puts forward in the "*theory of factors*".

As we mentioned in a previous section, one main difference between the construction of machines and organisms is that one occurs centripetally and the other centrifugally, respectively. Machines are built by an external factor, the human creator. Organisms, however, develop from a primordial single cell. Accordingly, in living beings, the guiding factor should not be found outside but inside the first cell, the germ. In all cells we find protoplasm and a nucleus. Inside the nucleus there is the natural factor: the genes. "As function is bound to definite material organs, so is genesis bound to certain material particles in the nucleus of the germ-cell, which are called the genes" (von Uexküll 1926, p. 234). Von Uexküll states that the genes are composed of a material basis called the ferment, which is present in the chromosome in a latent form (von Uexküll 1926, p. 214). This element merely establishes that each gene has a definite place in each individual cell. The material component, however, is not enough to explain the guidance of morphogenesis. There is also another element. As in the case of the human action, von Uexküll calls this directing element the impulse.

At this point, we only want to provide a brief summary of the role of the impulse in morphogenesis. The analysis of its nature and place in von Uexküll's biological theory will be made in a later chapter. According to von Uexküll, in morphogenesis, impulses are the intermediaries between non-spatial rules (as expressed in the *Bauplan*) and protoplasm (von Uexküll 1926, p. 218). It is a non-material factor that connects conformity with plan (*Planmässigkeit*) with the protoplasmic component of a cell, thus guiding morphogenesis (von Uexküll 1926, p. 230).

In cells, the whole gene is therefore created when the impulses invade them and the ferments inside them (von Uexküll 1926, p. 215). We can therefore say that "a gene or factor, then, is a ferment activated by an impulse" (von Uexküll 1926, p. 217). Due to this combination, von Uexküll calls genes "impulsive", meaning that they have the power to "convert an extra-spatial and extra-temporal plan into a physical phenomenon" (von Uexküll 1926, p. 216).

In von Uexküll's theory of factors, the genes present are the primary natural factors, located in the germ of the growing organism. "(…) a material basis consisting of ferments, which, through their relations to the impulses, become independent factors (…)"[75] (von Uexküll 1928, p. 160).

Unlike the mechanical (mosaic) and chemical theories of genesis, there is not any kind of hidden framework in the first cell: "The young germ, therefore, does not carry the construction plan stamped on itself in any material form. The protoplasm is gradually acquiring a structure according to plan, it does not house it from the beginning."[76] (von Uexküll 1913a, p. 42). Consequently, the directing of the ontogeny is provided by the plan outside of the framework, which is a framework-forming agent (von Uexküll 1926, p. 195).

In summary, how does the process of morphogenesis take place? In genes, from the perspective of causality, we see a ferment which produces certain physical and chemical effects in the protoplasmic foam. However, during the first steps of development, there is no framework in the cell, only protoplasm, which means that the ferment must act according to an arrangement that is not anatomically present at the time. The impulses transmit the conformity with plan to the protoplasm, ensuring that the framework produced is that of the *Bauplan*, the building plan of the organism. "The newly discovered natural force works rhythmically according to a definite plan, so that it must be called a rule. The agency through which it materialised itself we called the impulse, and we identified it with the impulse that precedes our own voluntary actions" (von Uexküll 1926, p. 235).

4.C.4 – Rules of Genesis and Function

The pathway described above highlights the developmental steps of organisms. Von Uexküll calls this the rule of genesis: "(…) everywhere there are genes, which are stimulated by a definite sequence of impulses to shape protoplasm in a definite direction" (von Uexküll 1926, p. 229). Additionally, "To the question 'how does a rule affect the protoplasm of the germ?' when considering the super-mechanical capabilities of this protoplasm, we answered that it orders the impulse sequence of the protoplasm"[77] (von Uexküll 1928, p. 148).

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[75] (...) eines materiellen Substrats, das aus Fermenten besteht, die durch ihre Beziehungen zu den Impulsen zu selbständigen Faktoren werden (...)

[76] Es trägt also der junge Keim den Bauplan in irgendeiner materiell ausgeprägten Form nicht in sich. Das Protoplasma gewinnt erst nach und nach eine planmäßige Struktur, es beherbergt sie nicht von Anfang an

[77] Die Frage: wie wirkt eine Regel auf das Protoplasma des Keims? haben wir bei Betrachtung der übermaschinellen Fähigkeiten des Protoplasmas dahin beantwortet, daß sie die Impulsfolge des Protoplasmas ordnet

But what happens when development is over? Like machines, organisms are first built up (the framework is produced) and then begin working. There appear therefore to be two distinct phases in the life of living beings. There is a rule directing the genesis of the organism and a rule, fixed in the framework, guiding its functions: "The life of such animals falls into two distinct parts. In the first, the organs are formed; in the second, they are used. In the first, the rule of genesis is in control; in the second, the rule of function" (von Uexküll 1926, p. 210). In other words: "(…) the rule of genesis controls the impulses in the embryo, the rule of function the impulses in the adult." [78] (von Uexküll 1928, p. 189). The developmental phase "presupposes a linear, irreversible flow of time with the full-formed organism as its endpoint" (Magnus 2011, p. 42). In the functional phase, "all organs are restricted in their activities due to anatomical constraints on the one hand and adjustments to certain environmental conditions on the other" (Magnus 2011, p. 42). Here the objective is the maintenance of the normal life activities of the organism. (Magnus 2011, p. 42).

We are thus left with two main questions to solve: How is the rule of genesis connected to the rule of function? And consequently, how is the functioning of an organism in conformity with plan?

Going back to the analysis of unicellular organisms, we saw that there is evidence of the rule directing the successive formation of the organs. "The stimulus that reaches the amoeba first awakens the structure-forming gene; then an organ of movement from the unstructured protoplasm of the animal is produced. The same stimulus puts the newly acquired organ into activity, and it then returns to being dissolved"[79] (von Uexküll 1913a, p. 99-100). However, unlike multicellular organisms, there appears to be no distinction between a developmental and functional phase: "Origin and functioning of the organs occur in multicellular animals temporally separated from each other and never get confused in them. In single-celled, which dissolve their organs again and again, the temporal separation is not so easy to perform, although it is of course always visible in an individual organ. Because no pseudopodium can work, if it is not there yet"[80] (von Uexküll 1909, p. 23). In unicellular organisms we find that

[78] (...) die Entstehungsregel beherrscht die Impulse im Embryo, die Funktionsregel die Impulse im Erwachsenen.
[79] Der Reiz, der die Amöbe trifft, weckt erst das strukturbildende Gen, darauf entsteht aus dem strukturlosen Protoplasma des Tieres ein Bewegungsorgan. Der gleiche Reiz setzt das neu entstandene Organ in Tätigkeit und dann wird das Organ wieder aufgelöst.
[80] Entstehen und Funktionieren der Organe treten bei den mehrzelligen Tieren zeitlich getrennt voneinander auf und werden dort niemals verwechselt. Bei den Einzelligen, die ihre Organe immer wieder auflösen, ist die zeitliche

the rule of genesis is connected to the functional rule to the point where we cannot tell them apart. Furthermore, the necessary organs appear in succession according to the needs of the organism, indicating that the functional rule regulates the rule of genesis: "[the rule of genesis] lies therefore completely under the rule of function, and, as soon as the function begins, merely furnishes it with the framework it lacks (von Uexküll 1926, p. 209-210). Consequently, "in unicellular animals the rule of genesis and the rule of function simultaneously affect the course of the impulses" (von Uexküll 1926, p. 217).

Given that in unicellular animals the two rules are connected, it is almost impossible to tell when one is acting and not the other. But in higher animals, the interlocking of the two rules disappears: they are composed of permanent organs. The rule of genesis and the functional rule are temporally separated, and we can observe them independently. Crucially, and this is what concerns us now, we can look for the moment when they connect, when the rule of genesis gives place to the functional rule: this is the "critical point".

In the initial stages of development, there is a very large number of possibilities included in the genes of each cell. By the guidance of the impulses, the protoplasm can produce a wide array of organs according to the *Bauplan*. However, unlike unicellular organisms, these organs are permanent. Throughout development, as the framework is produced, the effect of the impulses therefore becomes more restricted, and the number of possibilities gradually reduces. "What the subject gains in shape it loses in fresh life-possibilities" (von Uexküll 1926, p. 216). Additionally, protoplasm is transformed into a framework and the super-mechanical properties (morphogenesis, regulation and regeneration) are gradually lost, while the organism becomes more and more like a machine. We can thus say that: "the framework restricts framework formation" (von Uexküll 1926, p. 216). Eventually, all that is left in each cell is a remnant of protoplasm, that does not become part of the framework. (von Uexküll 1926, p. 211-212; p. 216). This whole process culminates in what von Uexküll calls the critical point: "that moment when the subject, on completion of its shaping process, suddenly finds itself in possession of a framework that is fully developed and capable of functioning"[81] (von Uexküll 1928, p. 173). Before this point, the guidance of the impulses was under the control of the rule of genesis, but

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Trennung nicht so leicht durchzuführen, obgleich sie am Einzelorgan natürlich immer sichtbar ist. Denn kein Pseudopodium kann funktionieren, wenn es noch nicht da ist.

[81] (...) bezeichne ich denjenigen Moment, da das Subjekt nach Beendigung seines Gestaltungsprozesses sich plötzlich im Besitz eines fertig ausgebildetcn und funktionsfähigen Gefüges befindet.

now it passes to the rule of function: “With the completion of the framework, function sets in; function which, on the one hand, seems an outcome of the finished machine, but, on the other, controls it, for its rule is now substituted for the rule of genesis, and, in accordance with plan, guides the course of what happens” (von Uexküll 1926, p. 217).

Ultimately, we return to the point where we began this analysis, but now with a deeper understanding of the origin of the framework of the organisms in conformity with plan. We had started by noticing how the *Bauplan* itself provides no indication of how it was built, meaning that the rule of function has to be different from the one that gives rise to it. The rule of genesis explains how a super-mechanical property is conferred by the action of the impulses. The impulses guide the formation of organisms, but they are not material and not spatial. Working with the plan, they guarantee that the framework produced by protoplasm is also in conformity with plan.

4.C.5 – Super-mechanical Properties

The analysis so far has shown that the rule of genesis reveals the super-mechanical property of organisms: the action of the impulses on protoplasm. But, at the end of morphogenesis, as the framework is complete, the functional plan gets determined. The functions of the machine can therefore be analysed using physico-chemical laws: “The completed framework, working in accordance with plan, does not show the slightest departure from causality” (von Uexküll 1926, p. 230). However, we should remember that while most of the protoplasm was transformed into the framework, some of it remained in the cells of the organism. This means that even in the adult, the impulses can act on the protoplasm, thus revealing super-mechanical properties.

Besides the property of morphogenesis, we find in adult living beings two other super-mechanical properties: regulation and regeneration: “Where a permanent framework has arisen, as in the majority of living creatures, the formative activity of the rule persists, and is exhibited in the super mechanical regulation and repair of injured parts” (von Uexküll 1926, p. 153).

Regulation in living organisms can be of different kinds. There is a type of external regulation: it “proceeds from every external stimulus and consists in the fact that the stimulus

acts on the animal only as long as the animal has not yet escaped its sphere of activity"[82] (von Uexküll 1909, p. 25). There is also one kind of internal regulation that is provided in the *Bauplan* of the organism. Both of these types are purely mechanical. But there is a third kind of regulation, another type of internal regulation. This one requires changes in the *Bauplan* of the organism. It is therefore a super-mechanical type of regulation (von Uexküll 1909, p. 25). We can find the most obvious example in unicellular organisms. Here the functional rule directs the rule of genesis, and the *Bauplan* is constantly changing as the different organs are formed and later destroyed depending on the needs of the organism (von Uexküll 1909, p. 26). The machines are completely alien to the capacity to change their building plan, adapting to changing exterior conditions (von Uexküll 1913b, p. 178).

As regards regeneration, this property may reveal itself when an organism loses a part of its tissue. As mentioned, when an organism is developing, its protoplasm is gradually transformed into the framework, with only a small amount remaining in the cell. When the framework is completed, the organism starts working mechanically, that is, only according to the laws of causality. However, when the organism suffers an injury, it becomes apparent that in addition to causality, there is a plan at work (von Uexküll 1926, p. 231).The organism's unused protoplasm is capable of receiving impulses, and these act on the damaged place. Consequently, there is a rule directing that a new framework gets produced and repairs the injury (von Uexküll 1926, p. 153; p. 230). In unicellular organisms there is a higher capacity for regeneration, since the ability to produce frameworks is also higher: "This permits regeneration after extensive injury, to a much greater degree than is possible among higher animals" (von Uexküll 1926, p. 212).

Machines are not capable of executing repairs in their own bodies (von Uexküll 1913b, p. 178). The main difference is that in machines, the rule is active at a certain time and fixed in the framework. Acordingly, after an injury it cannot repair itself: "How could the repair take place if the rule governing this were lost though the breaking up of the structure?" (von Uexküll 1926, p. 208). Organisms, however, are continually under the influence of the rule: "Moreover it has been overlooked that every machine in course of time wears out, if there be no direction continually disposing of the damage. So there must always be a super-mechanical rule of direction coming in to keep the mechanical running in working order. Here we have before us,

[82] (...) die von jedem äußeren Reiz ausgeht und darin besteht, daß der Reiz nur solange auf das Tier einwirkt, als das Tier seinem Wirkungskreis noch nicht entgangen ist.

in concrete form, direct invasion by the control, for cell-division cannot be effected by any mechanical rule of working" (von Uexküll 1926 p. 289)

4.C.6 – Conclusion

At this point we should recall our main question: how does von Uexküll biological theory compare to Driesch's ideas? In Driesch's case we saw that there is a dynamic factor behind the static teleological understanding of organisms. What about von Uexküll? Is there also a dynamic factor behind the *Bauplan*?

In this chapter we focused on describing von Uexküll's biological theory. His most important claim is that all living beings exist in conformity with a plan. Additionally, looking into the super-mechanical properties of morphogenesis we started uncovering the role of this conformity and the true nature of the *Bauplan*. We saw that conformity with plan is introduced into an organism through the action of an intermediate factor: the impulse. This shows us how the *Bauplan* can indirectly affect the protoplasmic material of an organism meaning that it is not just the latter's spatial and functional organization. We could ask ourselves: isn't the action of the impulses just like the active guiding factor postulated by Driesch's vitalistic position?

At this point, however, we cannot reach the full extent of our inquiry because we do not yet have a full comprehension of what von Uexküll means by *Bauplan*. All the characteristics that we have introduced so far are still insufficient, and our reconstruction of von Uexküll's *Bauplan* remains simplified and incomplete. In order to complete the picture, we need to tap into a decisive aspect of von Uexküll's theory, one that turns his perspective into a unique one: the concept of *Umwelt.*

Chapter 5 – Jacob von Uexküll: *Umwelt*

5.A – The Surrounding World

So far, we have studied both how the organism is structured and the origin of organization as such. In the development of an organism the only factor we have to account for is the succession of steps that give rise to a whole individual. But, as an organism becomes fully developed, its

main functions shift from its formation towards its interaction with the outside world. The actions of this organism now concern functions such as detecting and capturing food, evading enemies and recognizing sexual partners. The *Bauplan* should not therefore only be concerned with the form of organisms. It also accounts for the interaction of an individual with the world that surrounds it. As Weiss puts it: "Embryological processes, however, are not the only field where a plan is found to be at work. The behaviour of a finished adult and all the functioning of its life conform to a plan as well. To this problem of the animal's life in its world Uexküll has given special attention" (Weiss 1948, p. 49).

We are thus faced with a new stage in the understanding of biology. As mentioned in the Introduction, Martin Heidegger describes this two-step development in the following terms: the first step was provided by Driesch, by focusing on the wholeness of organisms, as opposed to them being just an aggregate of functional parts. Heidegger says: "What is essential is simply the fact that an organism as such asserts itself at every stage in the life of the living being. Its unity and wholeness is not the subsequent result of proven interconnections" (Heidegger 1995, p. 262). But the focus is functional: "This wholeness takes effect in every moment of the duration of the organism and its motility. Thus, this wholeness is not simply to be grasped as a mere result as distinct from a combination of elements." (Heidegger 1995, p. 264). The idea of an organism as a whole is expressed in von Uexküll's views through the concept of conformity with plan (*Planmässigkeit*), as we saw in the previous sections. Heidegger, however, also points out how Driesch failed to adequately unite the organism with its environment, thereby failing to deliver the second essential step in biology: "(…) we can see that the organism is certainly grasped as a whole here, yet grasped in such a way that the animal's relation to the environment has not been included in the fundamental structure of the organism. The totality of the organism coincides as it were with the external surface of the animal's body." (Heidegger 1995, p. 262). According to Heidegger, this step was provided by von Uexküll, with his "insight into the *relational structure between the animal and its environment*" (Heidegger 1995, p. 263). This means that this relationship is "inherently necessary to understanding both organism and environment" (Buchanan 2008, p. 52). We are thus left wondering: how does von Uexküll's biological theory explain this *relational structure* in his biological theory?

5.A.1 – Von Uexküll's Concept of Subject

As before, we find our starting point in the analogy between machines and organisms. Similarly, we need to work our way up to organisms, in order to find their exclusive properties, at which point the analogy is no longer valid. We should therefore start by asking: what do we mean by the outside world of a machine?

First, we can note that, in fact, several machines are useful for the perception (*Merken*) of the environment. Here we find examples such as eyeglasses and telescopes for visual perception, and microphones and radios for auditory perception. There are also machines that we use to produce actions (*Wirken*) on their surroundings. Such as all kinds of tools, factory components and means of transportation (von Uexküll 2010, p. 41). Does this apply to organisms as well? As we stated throughout the previous sections, the functioning of an organism can, to a certain extent, be compared to that of a machine.

From a mechanistic perspective, the perception and actions of an animal vis-à-vis the outer world are the same as a machine's: "From this one can readily assume that an animal is nothing more than a selection of suitable effect-tools and perception-tools, which are bound up into a whole by a control device which, though it remains a machine, is nonetheless suitable for exercising the vital functions of an animal"[83] (von Uexküll 1956, p. 21). In organisms we can also find organs suited to the reception of stimuli from the exterior (sight, sound, smell, touch etc.) and organs suited to producing different kinds of action (locomotion, feeding, reproduction etc.).

How far does the analogy hold up? The analysis made in the previous section argued that phenomena of life cannot be fully understood by restricting our analysis to physico-chemical laws. Living beings are not just a combination of effector and receptor tools like a machine. They are subjects. "Animals are made thereby into pure objects. In so doing, one forgets that one has from the outset suppressed the principal factor, namely the subject who uses these aids, who affects and perceives with them."[84] (von Uexküll 1956, p. 21).

What does von Uexküll mean by subject?

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[83] Es liegt nun nahe anzunehmen, ein Tier sei nichts anderes als eine Auswahl geeigneter Merkzeuge und Werkzeuge, die durch einen Steuerapparat zu einem Ganzen verbunden sind, das zwar immer noch Maschine bliebe, aber trotzdem geeignet wäre, die Lebensfunktion eines Tieres auszuüben.

[84] Die Tiere werden dadurch zu reinen Objekten gestempelt. Dabei vergißt man, daß man von Anfang an die Hauptsache unterschlagen hat, nämlich das *Subjekt*, das sich der Hilfsmittel bedient, mit ihnen merkt und mit ihnen wirkt.

Hopefully, the idea will become clearer by the end of this chapter, but it is useful to introduce the concept here. According to von Uexküll, organisms are subjects "whose essential activities consist in perception and production of effects"[85] (von Uexküll 1956, p. 22). But these characteristics are not sufficient to justify the existence of subjectivity. We could also say that machines perceive and act, yet they are objects, not subjects. Here von Uexküll is hinting at the significant difference between organisms and machines. Machines are built by an external agent, and their *Bauplan* is provided by their builder. Their functioning is therefore completely derived from the actions of this builder. Organisms, on the contrary, are autonomous in their activity. Their *Bauplan* does not derive from an external agent. (Pobojewska 2001, p. 324). "So far as we can judge at present, to be alive and to be a subject mean the same thing. To be a subject means, namely, the continuous control of a framework by an autonomous rule, in contrast to a heteronomous rule that loses its efficacy as soon as the framework is disturbed" (von Uexküll 1926, p. 223). The guidance of the operations of organisms therefore works like a machine operator: "(…) each and every living thing is a subject living in its own world, of which it is the centre. It cannot, therefore, be compared to a machine, only to the machine operator who guides the machine."[86] (von Uexküll 1956, p. 24).

Additionally, living beings are organized in conformity with a plan that confers special properties, the super-mechanical properties (morphogenesis, regulation and regeneration). As Pobojewska affirms: "The necessary condition for a sovereign activity is that the subject is an a priori form, that is, one existing before any experience, a form which is called by Uexküll the building plan (der *Bauplan*)." (Pobojewska 2001, p. 324).

As we mentioned in the previous section, the conformity with a plan in animals, or subjects, does not only therefore correspond to the specific organization of their parts (as in machines). It stands for a regulating factor that is capable of active intervention in the natural processes of organisms. "All subjects have a rule of function of their own which expresses itself not only in the framework, given once and for all, and in the activity thereof, but is also able to repair all frameworks within certain limits; consequently this rule represents a natural factor that is continually operative" (von Uexküll 1926, p. 223)

[85] (...) sondern als Subjekte ansprechen, deren wesentliche Tätigkeit im Merken und Wirken besteht.
[86] (...) daß ein jedes Lebewesen ein Subjekt ist, das in einer eigenen Welt lebt, deren Mittelpunkt es bildet. Es darf daher nicht mit einer Maschine, sondern nur mit dem die Maschine lenkenden Maschinisten verglichen werden.

Now, the above might suggest that the subject only corresponds to the animal itself, limited to its body. This means that there would be, on the one hand, the body of the animal and, on the other, its environment, everything else around it, outside of its body. As mentioned by Heidegger in a previous quote, according to this view there is the organism as a whole, but the environment only has a superficial interaction with the body of this whole. It is not part of the fundamental structure of the organism.

However, this is not von Uexküll's understanding of what the word "subject" stands for. There is not a separation between the body and the environment, between the subject and the objects. As Heidegger highlights, in von Uexküll's view the concept of subject is intrinsically connected to its object, its environment. Pobojewska summarizes: "As a result, the object exists solely through its relationship to the subject, but also the subject can be defined only in its relationship to the object. Thus, then, the subject and the object are not distinct, independently existing beings but inseparable elements of a relationship." (Pobojewska 2001, p. 324).

If the subject and object are intrinsically connected, then what is the role of the *Bauplan* of the organism? Biology, which investigates the conformity with plan of organisms, is not restricted to their bodies, like physiology, but includes animal's surrounding worlds. As summarized by Favareau: "In distinction to physiology, biology has to use the scientific method to go beyond the investigation of causalities by exploring the laws that [account for] the purposefulness of living matter. Therefore, biology should study organisms not as objects, but as active subjects, thus focusing on the organism's purposeful abilities that provide for the active integration into a complex environment. Biology therefore had to deal with holistic units and to maintain a broader scope than physiology in order to grasp the interactive unity of the organism and the world sensed by it." (Favareau 2010, p, 41).

Beyond the inherent connection between a subject and its world, there is a second aspect that we have to consider before moving forward. It is that, for von Uexküll, each subject creates its own world. As we will see, this is precisely what "subject" in the Uexküllian sense of the word is all about. There is not one absolute world, but several subjective ones: "According to the physicist, there is only one real world; and this is not a world of appearance, but a world having its own absolute laws, which are independent of all subjective influence. (…) The biologist, on the other hand, maintains that there are as many worlds as there are subjects, and that all these worlds are worlds of appearance, which are intelligible only in connection with the subjects" (von Uexküll 1926, p. 70). This idea will be developed in more detail later.

It is important to note what von Uexküll says about these different worlds. In his works he focuses, at great length, on the differences between the surrounding worlds of different species. According to him, all organisms experience the *Umwelt*, except fungi and plants. The absence of a nervous system in plants is decisive: "A plant's house does without the nervous system; it lacks the perceptual? and effector organs (*Merk- und Wirkorgane*). As a consequence, there are no carriers of meaning (*Bedeutungsträger*) for a plant, no functional cycles, and no notes and actions (*keine Merkmale und keine Wirkmale*)."[87] (von Uexküll 1956, p. 111).

When describing the surrounding world of plants and fungi, von Uexküll uses the terms *Wohnwelt* (dwelling-world) or *Wohnhülle* (dwelling-shell) instead of *Umwelt*: "The plant possesses no special surrounding world organs (*Umweltorgane*) but is immediately immersed in its dwelling-world (*Wohnwelt*). The relations of the plant to its dwelling-world are completely different from those of animals to their surrounding world (*Umwelt*). Only regarding one point do the building plans (*Baupläne*) of animals and plants agree with one another: Both make a precise selection from among the effects of the outer world (*Außenwelt*) that press in upon them."[88] (von Uexküll 1956, p. 111). The same is true for fungi: "However, the finished fungus (*Pilz*) is a plant that has no animal surrounding world but only a dwelling-shell which consists of meaning factors (*Bedeutungsfaktoren*)."[89] (von Uexküll 1956, p. 111)[90].

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[87] Das Haus der Pflanzen entbehrt des Nervensystems, ihm fehlen die Merk- und Wirkorgane. Infolgedessen gibt es für die Pflanze keine Bedeutungsträger, keine Funktionskreise, keine Merkmale und keine Wirkmale.

[88] Die Pflanze besitzt keine besonderen *Umwelt*organe, sondern ist unmittelbar in ihre Wohnwelt eingetaucht. Die Beziehungen der Pflanze zu ihrer Wohnwelt sind durchaus andere als die der Tiere zu ihrer *Umwelt*. Nur in einem Punkte stimmen die Baupläne der Tiere und Pflanzen überein. Beide treffen eine genaue Auswahl unter den auf sie eindringenden Wirkungen der Außenwelt.

[89] Der fertige Pilz aber ist eine Pflanze, die keine tierische *Umwelt* besitzt, sondern nur von einer Wohnhülle umgeben ist, die aus Bedeutungsfaktoren besteht

[90] It is at this point that we start to notice how von Uexküll relates to the issue of the *scala naturae latiore sensu* – namely, the ranking system according to which there are four levels of organization in nature, in increasing order of complexity: *esse*, *vivere*, *percipere*, *intelligere*, that is, things that exist, that live, that feel and that think, respectively.

Firstly, von Uexküll does not seem to pay much attention to the transition from vegetal to animal, that is, from *vivere* to *percipere*. The lack of detail in this transition reveals von Uexküll's understanding of the *scala naturae*. In his view, the crucial step is the transition from the non-living (*esse*) to the animal (*percipere*) level. He is not as concerned with the in-between transition from vegetal (*vivere*) to animal (*percipere*), or, as we have termed above, from the vegetative to the more-than-vegetative. This means that in von Uexküll's conception we find a unity between *vivere* and *percipere*. The focus is not on the differences between them. At the end of the day, the main emphasis is on *percipere*, as the chief characteristic of the "animal world" (*N.B.* on *percipere* in a broader sense, in which it stands both for *Merken* and for *Wirken*).

Secondly, this has to do with one of the main features of the history of the *scala naturae* question. Most of its major developments are due a) to what might be termed *shifts of stress* (differences in what is toned up viz. accentuated, or what is toned down) and b) shifts of scale (differences in what components or transitions are viewed in detail or just in outline, etc.). This main feature also applies to von Uexküll's view on this matter: he does not engage with all the rungs of the *scala naturae* uniformly.

In short, von Uexküll's theory is based on both of these aspects: organisms are subjects, intrinsically connected to their surrounding worlds, which are exclusively subjective and not objective. Consequently, "one has opened the gateway to the surrounding worlds (…)"[91] (von Uexküll 1956, p. 22). The study of the surrounding worlds of organisms requires that we recognize their autonomy and conformity with plan. "Whoever wants to hold on to the conviction that all living things are only machines should abandon all hope of glimpsing their surrounding worlds."[92] (von Uexküll 1956, p. 21). The surrounding world (*Umwelt*) of a subject is a unit, where everything it perceives is part of the perceptive(perceptual) world (*Merkwelt*) and everything it produces belongs to the effector world (*Wirkwelt*) (von Uexküll 2010, p. 42).

5.A.2 – The Organism-*Umwelt* Unity

Regarding the concept of "subject" it is important to focus our attention on a step that could pass by unnoticed but is a game-changing one. If this aspect is overlooked, even resorting to an Uexküllian concept will leave us miles away from the true meaning of "subject" in the true Uexküllian sense.

What are we talking about? The fact that the organism-*Umwelt* unity can be understood in two very different ways and that only one of them is what von Uexküll has in mind.

On the one hand, we say that the organism-*Umwelt* unity is a "totality". And we understand it as a totality, but in such a way that it is also part of a more encompassing whole. The animal-*Umwelt* unity is, as it were, an island in the middle of an ocean constituted by a) the worlds of other species and b) the surrounding inorganic reality.[93] If the animal-*Umwelt* totalities von Uexküll is referring to are understood in this way, they are not really seen as

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[91] Damit ist aber bereits das Tor erschlossen, das zu den Umwelten führt (...)

[92] Wer an der Überzeugung festhalten will, daß alle Lebewesen nur Maschinen sind, gebe die Hoffnung auf, jemals ihre Umwelten zu erblicken.

[93] We can illustrate this understanding of the animal-*Umwelt* unity in a series of diagrams (See Appendix). These figures show how we usually conceptualize this unity, namely: a totality (A) surrounded by the inorganic world, and therefore part of a larger whole (Fig. 1). When other species are considered (Fig. 2 and 3) these subjective totalities – the different animal-*Umwelt* unities (B, C) – appear in the middle of the surrounding inorganic world, and they can either be completely disjoined (Fig. 2) or intersect each other (Fig. 3), yet always in the context of more encompassing totality.

something subjective, but rather as particular kinds of object among many others. And this is definitely not what von Uexküll's animal-*Umwelt* totalities are all about.

On the other hand, von Uexküll's total unity between the organism and its *Umwelt* – and this also means: von Uexküll's subject – can be understood in a completely different way; there is an essential link between subject and totality, namely because von Uexküll's subject (viz. the unity between an organism and its *Umwelt*) is a particular kind of "total totality" i.e. it is a) a *particular kind* of b) a *totum quod non est pars alterius* (a whole which is not part of another) (Kant 1997, p. 3).

This "a *particular kind* of a *totum quod non est pars alterius*" (a whole which is not part of another) seems to be an oxymoron. For, on the one hand, it speaks of a *particular kind* of totality – and therefore admits that there are other kinds beyond the one in question (in which case this particular kind of totality is just a part of something), while, on the other hand, characterizing the totality in question as a *totum quod non est pars alterius.* (a whole which is not part of another).

The key to understanding this oxymoron can be found in Kant's transcendental approach, particularly in his view on what he terms the "transcendental form of representation". The latter is at the same time a) something intrinsically subjective, b) just a possible way of representing (not the *only* possible way of representing, let alone real or adequate knowledge of independent reality *viz.* of "an-sich-reality"); it therefore leaves out much of reality, but in such a manner that nevertheless c) it shapes every possible object we can think of, so that *for us,* it is nothing less than all-encompassing: a *totum quod non est pars alterius.* This is the key point on which everything hinges.

Von Uexküll's totalities – his organism-*Umwelt* unit viz. his *Bauplan* unit – are a biological version, as it were, of Kant's transcendental form of representation (i.e of Kant's subjectivity). In von Uexküll's view, every species is both formed by and closed inside its own *Bauplan* (the unity between organism and *Umwelt* in the von Uexküllian sense of the word). The latter is the biological counterpart of Kant's transcendental form – and indeed what Kant's transcendental form of representation stands for[94].

[94] When all is said and done, the real identity of Kant's transcendental form of representation turns out to be nothing other than the "*Bauplan*" – namely the organism-*Umwelt* unity of our own species.

In short, in von Uexküll's view, each species has its own *Bauplan*, the latter is the real subject in the Kantian sense and therefore – for each species – the *totum quod non est pars alterius:* a particular kind of whole, that nevertheless *encompasses everything*, in such a way that it is everything for itself.

Let us close this section with two remarks on the connection between Kant's and von Uexküll's "subject" viz. their *totum quod non est pars alterius.* In our analysis we have emphasized the affinity between both, but there are two fundamental differences.

Kant's transcendental form of representation *viz*. Kant's "subject" (Kant's *totum quod non est pars alterius*) is purely gnoseological. As pointed out above, von Uexküll's subject, viz his *totum quod non est pars alterius*, is the biological version of that view. The subject is the shape of life itself; life is intrinsically subjective.

Secondly, Kant speaks of an invariable subject: of an invariable transcendental form of representation. Whereas in von Uexküll's view there is not just one (one kind of subject, one kind of *totum quod non est pars alterius*): there is a wide variety of them – namely, one for each species. In short: Kant's transcendental subject is but a particular case, corresponding to our own special *Bauplan*. Each *Bauplan*-related-soap-bubble is as total and all-encompassing as any other – namely for itself.

We can also express this by saying that there is a shift of emphasis: in von Uexküll's biological view the main emphasis is placed on the paradoxical idea of various *tota quae non sunt partes alterius*.[95]

5.A.2 – The Biological Form of Representation

In order to describe the idea of *Umwelt* as the world surrounding the animal, von Uexküll uses the image of a soap bubble: "the space peculiar to each animal, wherever that animal may be, can be compared to a soap bubble which completely surrounds the creature at a greater or less distance. The soap bubble of the extended constitutes for the animal the limit of what is finite, and therewith the limit of its world; what lies behind that is hidden in infinity" (von Uexküll 1926, p. 42)

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[95] In note 93 we tried to illustrate the first way to understand von Uexküll's soap bubble viz. his organism-*Umwelt* unity by means of a diagram. Now the point is that it is impossible to try something similar for the second way of understanding it. A diagram is a Gestalt against a background. But the point in being a *totum quod non est pars alterius* is precisely that it cannot be a Gestalt, for it is all-encompassing in the strictest sense of the word.

We can see this concept illustrated several times in von Uexküll's works through the example of the tick: After mating, the female tick's reproductive cycle is only finished after feeding off the blood of a warm-blooded animal. It accomplishes this by positioning itself at the edge of a tree branch, waiting for a mammal to pass by. "The tick hangs inert on the tip of a branch in a forest clearing. Its position allows it to fall onto a mammal running past. From its entire environment, no stimulus penetrates the tick. But here comes a mammal, whose blood the tick needs for the production of offspring. And now something miraculous happens. Of all the effects emanating from the mammal's body, only three become stimuli, and then only in a certain sequence."[96] (von Uexküll 1956, p. 28). From the whole environment surrounding the tick at the tip of the branch, its *Umwelt* is composed of only three stimuli. All the other elements around it have no significance. The tick first detects the odour of butyric acid emanating from the mammal. This induces its release from the branch, falling onto the passing animal. As it lands on the animal, its locomotor organs are activated until it reaches a warm patch on the skin of the host, where it bites to suck the blood to feed itself (von Uexküll 2010, p. 50). Only these three elements have a meaning for the tick. As Buchanan puts it: "everything else does not factor as meaningful in any way; indeed, there is nothing else for the tick, even if there may be for another organism. It is on this point that we can see a parallel with other organisms." (Buchanan 2008, p. 25)

What kind of world is von Uexküll describing? The concept of *Umwelt*, especially through the image of the soap bubble, may lead us to believe that animals share a common world from which each individual recognizes its environment. Von Uexküll alludes to this idea: "We comfort ourselves all too easily with the illusion that the relations of another kind of subject to the things of its surrounding-world play out in the same space and time as the relations that link us to the things of our human surrounding world. This illusion is fed by the belief in the existence of one and only one world, in which all living beings are encased. From this arises the widely held conviction that there must be one and only one space and time for all living beings."[97] (von Uexküll 1956, p. 31). But, as we already mentioned, this is the perspective of

[96] Die Zecke hängt regungslos an der Spitze eines Astes in einer Waldlichtung. Ihr ist durch ihre Lage die Möglichkeit geboten, auf ein vorbeilaufendes Säugetier zu fallen. Von der ganzen Umgebung dringt kein Reiz auf sie ein. Da nähert sich ein Säugetier, dessen Blut sie für die Erzeugung ihrer Nachkommen bedarf. Und nun geschieht etwas höchst Wunderbares: von allen Wirkungen, die vom Säugetierkörper ausgehen, werden nur drei, und diese in bestimmter Reihenfolge zu Reizen.

[97] Nur allzu leicht wiegen wir uns in dem Wahne, daß die Beziehungen des fremden Subjektes zu seinen Umweltdingen sich im gleichen Raume und in der gleichen Zeit abspielen wie die Beziehungen, die uns mit den

physics, which von Uexküll finds insufficient: “Physical theory tries to convince the plain man that the world he sees is full of subjective illusions, and that the only real world is much poorer, since it consists of one vast, perpetual whirl of atoms controlled by causality alone”. (von Uexküll 1926, p. 71).

This is not the basis for von Uexküll’s conception of Nature: “On the other hand, the biologist tries to make the plain man realise that he sees far too little, and that the real world is much richer than he suspects, because around each living being an appearance world (*Erscheinungswelt*) of its own lies spread, which in its main features, resembles his world, but nevertheless displays so much variation therefrom that he may dedicate his whole life to the study of these other worlds without ever seeing the end of his task” (von Uexküll 1926, p. 71).

We have already introduced this first aspect of von Uexküll’s biological theory above: there is not one objective world; rather, each subject has its own world. As Weiss points out: “Each species has its specific structure, and correspondingly, its specific world. The animal's world is not identical with our world, nor is the world of one animal species the same as the world of another”. (Weiss 1948, p. 49).The *Umwelt* is therefore built by a subject itself, and beyond that there is no other kind of world. “Looking at a beech tree that rose up before him, [von Uexküll] suddenly had the thought: ‘This is not a beech tree, but rather my beech tree, something that I, with my sensations, have constructed in all its details. Everything [about the beech] that I see, hear, smell or feel are not qualities that exclusively belong to the beech, but rather are characteristics of my sense organs that I project outside of myself’." (von Uexküll, quoted in Harrington 1996, p. 41).

This is emphasized in von Uexküll’s decisive statement: “*All reality is subjective appearance*. This must constitute the great, fundamental admission even of biology. It is utterly vain to go seeking through the world for causes that are independent of the subject; we always come up against objects, which owe their construction to the subject” (von Uexküll 1926, p. XV, his emphasis). All we can tell is that the *Umwelt* of an animal is therefore distinct from our own and from other species: “Around each animal itself arches a new world, completely different from ours, its *Umwelt*”[98] (von Uexküll 1909, p. 6). Therefore, “it will become clear to

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Dingen unserer Menschenwelt verknüpfen. Genährt wird dieser Wahn durch den Glauben an die Existenz einer einzigen Welt, in die alle Lebewesen eingeschachtelt sind. Daraus entspringt die allgemein gehegte Überzeugung, daß es nur einen Raum und eine Zeit für alle Lebewesen geben müsse.

[98] (...) so rundet sich um jedes Tier eine neue Welt, gänzlich verschieden von der unsrigen, seine *Umwelt*.

us that the dog world is made up of dog things and the fly world is made up of fly things."[99] (von Uexküll 1928, p. 105). "Around each animal itself there is a new world, completely different from ours, its *Umwelt*"[100]. (von Uexküll 1909, p. 6).

The *Umwelt* is not a section of an absolute and objective world, but it is a subjective one. Thus, if we want to talk about the *Umwelt* as a section of some world, it is only as a section of the world of the observer (Pobojewska 2001, p. 330). And the latter is no more objective than any of the others[101]. It is not therefore possible to move outside of the framework created by the subjectivity of the observer himself, "he is always dealing with events that take place in *his* space and in *his* time and with *his* qualities" (von Uexküll 1926, p. 136, him emphases).

Different species are closed off from each other, meaning that we do not have a direct insight into the organism-*Umwelt* unity of another species, where everything – both the organism and its *Umwelt* – is shaped by a very different *Bauplan*. (von Uexküll 1928, p. 105). Consequently, all we can perceive of an animal's *Umwelt* is a part of our own *Umwelt*: "The animal's surrounding world, which we want to investigate now, is only a piece cut out of its environment, which we see stretching out on all sides around the animal—and this environment is nothing else but our own, human surrounding world"[102] (von Uexküll 1956, p. 30-31).

What we have just described allows us to see a second aspect in which von Uexküll revolutionises the traditional view on the *scala naturae latiore sensu*[103]. What is the second revolutionary change we are talking about?

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[99] Dann wird es uns klar werden, daß die Hundewelt sich aus Hundedingen und die Fliegenwelt sich aus Fliegendingen aufbaut.

[100] (...) so rundet sich um jedes Tier eine neue Welt, gänzlich verschieden von der unsrigen, seine *Umwelt*.

[101] It is important to reinforce this aspect. To be sure, the various soap bubbles he is talking about are all contained in the same world – that is what he is referring to and the reason why he speaks of *various* soap bubbles. But the point is that the encompassing world in question is strictly subjective. It is itself a "soap-bubble" – namely the observer's. We might also say that the various worlds von Uexküll is referring to are like prison cells – except that in this case the cells are utterly different from one another. Each inmate has access only to his or her own cell – and he or she can only *guess* what the other cells are like.

Hence, the task of biology is to *reconstruct* these different soap bubbles, not as an external, objective observer, but rather from the enclosure of our soap bubble (the one corresponding to our species). Biology is all about this particular kind of perspectivism. It has to gain insight into all the other soap-bubbles without ever leaving our own. In short, the emphasis is placed on the fact that biology is dealing with nothing less than *different worlds*. At the end of the day, otherness – viz. alterity – is what it is all about.

[102] Die Umwelt des Tieres, die wir gerade erforschen wollen, ist nur ein Ausschnitt aus der Umgebung, die wir um das Tier ausgebreitet sehen — und diese Umgebung ist nichts anderes als unsere eigene menschliche Umwelt.

[103] For the first aspect of this transformation see the end of Section 5.A.1

The traditional view is characterized by the fact that *esse* is, as it were, the root of everything else. It acts as the universal proto-determination. The point being that *vivere* is nothing but a transformed *esse*; *percipere* is nothing but a transformed *vivere* (and therefore a transformed *esse*), etc. Kant changed this whole view. To be sure, he does not change the traditional framework (the traditional *ephexês*-sequence) *esse-vivere-percipere-intelligere*. But in his view, this whole framework turns out to be the result and correlate of the transcendental form of representation (viz. of the transcendental connection between the transcendental form of *percipere* and the transcendental form of *intelligere*). In other words, according to Kant *esse* itself is something posited by *intelligere* (viz. by the said unity between *intelligere* and *percipere*) and the whole framework of connections between *esse, vivere, percipere* etc. is but an internal component of *intelligere* (viz. of the said unity between *intelligere* and *percipere*).

So far as regards Kant. But what about von Uexküll?

As we saw, like Kant von Uexküll claims that all reality is intrinsically subjective. However, unlike Kant he does not claim that this subjectivity is exclusive to the human *intelligere* (viz. to the above-mentioned unity between *intelligere* and *percipere*). In his view, it is rather a biological instance, namely what he terms the *Bauplan*. In other words, according to von Uexküll, the root of the *scala naturae latiore sensu* is nothing other than the fundamental unity between *vivere* and *percipere* (N.B. *percipere* in a broader sense, in which it stands both for *Merken* and *Wirken*). The result being that both *esse* and *intelligere* – and indeed the whole framework of *esse-vivere-percipere-intelligere* – there are internal components of the real *fons et origo* of the *scala naturae*, namely the biological root of everything: the *Bauplan* (n.b. our own *Bauplan*)

5.A.3 – The Methodological Issue

At this point we can recapitulate von Uexküll's specific understanding of "subject". It is crucial to recall that we are dealing with a subject that represents a totality and is not an element of an objective world. Each subject is a world for each animal, and the same holds true for us. Thus, enclosed in each subjective world we find a multiplicity of subjects and a multiplicity of worlds – the Uexküllian soap bubbles. In von Uexküll's words: "The biologist (…) maintains that there

are as many worlds as there are subjects, and that all these worlds are appearance-worlds, which are intelligible only in connection with the subjects"[104] (von Uexküll 1928, p. 61).

We can now introduce the nature of the *Bauplan*. It is, first, a biological form of these worlds, and each *Bauplan* stands for nothing less than one world (*totum quod non est pars alterius*). In other words, it is a biological counterpart to Kant's transcendental form of representation. Secondly, due to its subjective nature, the *Bauplan* is associated with the idea of a plurality of strictly subjective worlds, enclosed within the strictly subjective "soap bubble" of the observer.

Consequently, the *Bauplan* ties up all of the elements of the subjective worlds of living beings. The connection between all of these elements is the basis for von Uexküll's investigation, as he attempts to reconstruct the worlds of different organisms.

In the introduction to his 1909 book "*Umwelt und Innenwelt der Tiere*", von Uexküll describes this enterprise as "special biology": "The content of the present book is intended to serve the purpose of making the building plan (*Bauplan*) as meaningful as possible, and to use individual examples to show how the surrounding world (*Umwelt*) and the inner world (*Innenwelt*) are connected by the building plan. A textbook of special biology is not offered here, but only shows the way to get to it."[105] (von Uexküll 1909, p. 7).

An investigation into the nature of the organism-*Umwelt* unity, the "subject" in the Uexküllian sense, therefore coincides with the study of the *Bauplan*: "It is therefore irrelevant from which point one starts from when considering a whole according to plan (*ein planmässiges Ganzes*). Everything in it must interact. Consequently, we may begin either by studying subjects, or by investigating their surrounding worlds (*Umwelten*). The one could not exist without the other"[106] (von Uexküll 1928, p. 62).

5.A.3.1 – Some Difficulties

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[104] (...) behauptet der Biologe, daß es ebensoviel Welten gibt als Subjekte vorhanden sind, daß alle diese Welten Erscheinungswelten sind, die nur im Zusammenhang mit den Subjekten verstanden werden können.

[105] Der Inhalt des vorliegenden Buches soll dem Zwecke dienen, die Bedeutung des Bauplanes möglichst eindringlich vor Augen zu führen und an einzelnen Beispielen zu zeigen, wie *Umwelt* und Innenwelt durch den Bauplan miteinander zusammenhängen. Ein Lehrbuch der speziellen Biologie wird hier nicht geboten, sondern nur der Weg gezeigt, auf dem man zu ihm gelangen könnte.

[106] Deshalb ist es gleichgültig, von welchem Punkte man bei Betrachtung eines planmäßigen Ganzen ausgeht. Alles in ihm muß in Wechselwirkung zueinander stehen. Wir können daher sowohl mit der Untersuchung der Subjekte wie mir der Untersuchung ihrer *Umwelt*en beginnen. Eines wird ohne das andere nicht bestehen können.

We now reach the starting point of our investigation. But the preceding analysis of the nature of the subject also hinted at the major obstacles that this investigation has to overcome. What hurdles are these?

Firstly, the study of the different subjective worlds, that is the different *Baupläne*, appears to take a blow when we remember that the objects perceived[107] and acted on[108] by each subject, are inaccessible to an outside observer. As Pobojewska puts it: "We may perceive some different animals and objects surrounding them; however, it is not their *Umwelt* but their environment (*Umgebung*). The object perceived by us may be a different object for different animals if they possess different building plans (*Bauplan*) [sic], according to which they shape their things. The objects of the *Umwelt* of a given subject can be cognized only if its building plan is known." (Pobojewska 2001, p. 329). Additionally, this delimitation acts as a barrier that prevents the external observer from entering the organism's environment and fully comprehending its *Umwelt* (Buchanan 2008, p. 25).We thus have a "collection of 'soap bubbles' inaccessible from the outside of the worlds of given subjects" (Pobojewska 2001, p. 325).

This limitation carries within itself a temptation. Due to the inescapable subjective nature of the observed world, there is the danger that we, the external investigator, anthropomorphise the worlds of the different animals that we are trying to understand. What an observer detects does not correspond to the *Umwelt* of an animal, but to something very different. As Weiss remarks: "Each animal's specific world (*Umwelt*) differs from what we call its surroundings, which are noticeable to man (*Umgebung*)" (Weiss 1948, p. 49). That is, an observer can never move out of the enclosure of his own soap bubble and this subjectivity introduces an intrinsic defect in the recognition of world different from our own: "It is not possible even for the biologist to transfer the event observed by him (as in the case of an animal influenced by an external object) outside the frame created by his own subjectivity" (von Uexküll 1926, p. 135-136).

We thus have to be careful in identifying which elements are introduced by the observer and which ones are from the world of another animal. The right method should consist in discerning which elements have in fact a role in the environment of the organism, or most importantly, which ones do not: "Of course, it is not difficult to observe any animal in its

[107] The objects of *Merken*
[108] The objects of *Wirken*

environment (*Umgebung*). But that does not solve the problem. The experimenter must seek to determine which parts of this environment (*Umgebung*) affect the animal and in what form that happens. Our anthropocentric approach has to recede more and more, and the animal's standpoint alone has to be decisive."[109] (von Uexküll 1909, p. 6).

Here lies the first main difficulty: as an investigator von Uexküll is hindered by the fact that he does not have a direct access to these worlds. He works like a detective that has just arrived at the scene of the crime and must reconstruct it without having witnessed the actual events of the crime in question. Consequently, how is he able to cross the subjective barrier, to understand the various soap-bubbles of other organisms?

Secondly, this effort is further complicated when we recall that with each species we have a different *Bauplan*, which means a different world, and a different form of representation: "Only a superficial look may make it seem as if all marine animals live in a uniform world common to all. A closer look shows us how each and every one of these hundreds of different life forms possesses its own specific environment [*Umwelt*], which is mutually dependent on the building plan (*Bauplan*) of the animal"[110] (von Uexküll 1909, p. 5). This means that our starting point is to recognize that we are faced with a practically infinite variety of worlds, each one of them unique, in accordance with each species. The prospect of studying all these kinds of world is staggering because for each investigative effort the journey is different –each time we have a new species, a new *Bauplan* and a new world: that of the paramecium, the anemone, the tick etc.

How do we solve this? It seems as if each species is aiming for its own destiny, each one setting off in a completely different direction. We cannot deny that we have an immensity of worlds, each one unique and specific, and furthermore, intrinsically inaccessible. How can we understand the "relational structure between the animal and its environment" if we are unable to reach the *Umwelt* of other organisms besides our own?

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[109] Es ist freilich nicht schwierig ein beliebiges Tier in seiner Umgebung zu beobachten. Aber damit ist die Aufgabe keineswegs gelöst. Der Experimentator muß festzustellen suchen, welche Teile dieser Umgebung auf das Tier einwirken und in welcher Form das geschieht. Unsere anthropozentrische Betrachtungsweise muß immer mehr zurücktreten und der Standpunkt des Tieres der allein ausschlaggebende werden.

[110] Nur dem oberflächlichen Blick mag es erscheinen, als lebten alle Seetiere in einer allen gemeinsamen gleichartigen Welt. Das nähere Studium lehrt uns, daß jede dieser tausendfach verschiedenen Lebensformen eine ihm [sic] eigentümliche *Umwelt* besitzt, die sich mit dem Bauplan des Tieres wechselseitig bedingt.

5.A.3.2 – Comparative Strategy

What is von Uexküll's strategy for overcoing these barriers? As we will see, he opts for a comparative strategy. What does this mean?

As we have just described, the starting point is that we cannot access the *Umwelt* of any species whatsoever. But we started by recognizing that there is an anatomical-physiological alphabet and an *Umwelt* for each species. Each species has its own organism-*Umwelt* unity that can be formalized in a certain way, regardless of our inability to gain direct access to it. In other words, there is a biological form to the organization of each species – the *Bauplan*. We therefore know that interactions of an organism with its surrounding world are formalized in a certain anatomical-physiological alphabet.

Here lies the basis for our research: even if we cannot enter the *Umwelt* of other species directly, we can always observe how an organism interacts with the exterior world. As Pobojewska puts it: "The scientist investigates this relationship, that is, the behavior of the living organisms in their being directed towards the external world, and on this basis draws conclusions about objects specific for a given subject." (Pobojewska 2001, p. 329). And eventually, as we have described, uncovering the nature of the organism-*Umwelt* unity also reveals the *Bauplan*: "Discovering the form of the objective world of the living being, the research worker reveals its a priori plan as they are identical" (Pobojewska 2001, p. 329).

However, we should note that, even in this way, the subjective barrier is not fully surpassed. A complete understanding of a single species is *a priori* denied to an external observer. It is here that von Uexküll opts for a different approach. His method is not based on looking into each species separately and in isolation from the others. Instead, he studies several examples of species in order to find the common denominators between them. Based on the shared biological alphabet that formalizes the interactions of each organism and the surrounding world and the study of different organism *Baupläne,* von Uexküll therefore identifies the shared elements of the different worlds. This comparative method is at the basis of what von Uexküll previously called "special biology": "What may arise in the manner just outlined is a special biology of all animal species. Such a biology would be very one-sided if it renounced the aid

of comparison. All animals perform their animalistic activities with the help of tissues that remain very similar throughout the whole animal series"[111] (von Uexküll 1909, p. 8).

The comparative method is put into action by observing the activities of each species as they go through their daily routines: "This means analysing the different responses of an animal in the setting of its normal life" (von Uexküll 1926, p. 141). Our expectation is always to look for those performances (*Leistungen*) which are common between all species – their common denominators. Von Uexküll identifies them as the actions of locomotion, food detection, battle with the enemy and sexual interaction (von Uexküll 1928, p. 105).

It is here that the solution starts to reveal itself. The role of an investigator is to search for the path between these denominators and the alphabet of each species. Starting from these bits of information, once again we find von Uexküll working like a true detective. As Schroer points out: "piecing together the different aspects of their behaviour through observation" (Schroer 2019, p.3). In von Uexküll's words: "The surrounding worlds, which are as diverse as the animals themselves, offer every nature lover new lands of such richness and beauty that a stroll through them will surely be rewarding, even though they are revealed only to our mind's eye and not to our body's."[112] (von Uexküll 1956, p. 22).

In order to complete this connection, we have to recognize which elements in the behaviour of organisms actually correspond to an interaction between the organism and its *Umwelt*. An effect or behaviour observed by an investigator may in fact correspond to the interaction between a subject and its *Umwelt*, or it may not. The simple observation of a reaction by an organism may not correspond to a natural process. How can we tell the true processes from the ones projected by us? Only by inferring which ones reach the nervous system of the organism. "From the effects of the environment (*Umgebung*), the receptors select those stimuli (*Reize*) which, according to an animal's building plan (*Bauplan*), are likely to be noticed and then give a sign (*Zeichen*) to the nervous system as soon as the stimulus in question takes effect in the environment. You can therefore determine how many signs an animal receives from its

[111] Was auf die eben dargelegte Weise entstehen kann, ist eine spezielle Biologie aller Tierarten. Eine solche Biologie würde sehr einseitig sein, wenn sie auf das Hilfsmittel der Vergleichung verzichtete. Alle Tiere vollführen ihre animalischen Leistungen mit Hilfe von Geweben, die sich durch die ganze Tierreihe hindurch sehr ähnlich bleiben.

[112] Die *Umwelt*en, die ebenso vielfältig sind wie die Tiere selbst, bieten jedem Naturfreunde neue Länder von solchem Reichtum und solcher Schönheit, daß sich ein Spaziergang durch dieselben wohl lohnt, auch wenn sie sich nicht unserem leiblichen, sondern nur unserem geistigen Auge erschließen.

surrounding world (*Umwelt*) – so many stimuli, so many signs. If an animal has received a sign from its environment in this way, it must give an answer."[113] (von Uexküll 1909, p. 59)

At the end of the day, thanks to these methodological devices von Uexküll tries to avoid the anthropocentric temptation in this investigation. We are no longer restricted to a subjective transformation of the action of other living beings. The comparative method gradually uncovers the connection between the common denominators (the shared "performances" between organisms) and the specific alphabet of each organism. In this way von Uexküll is able to produce a scheme that is shared between all organisms.

The result is that we find what might be termed a meta-alphabet: the alphabet of all "species-alphabets" (the underlying alphabet of all specific alphabets). In other words, on a first level we have the alphabet of the *Bauplan* of each species, and now we find the joint supra-alphabet for the alphabet of each species. As we will see, this common scheme is detected at the basis of all of the processes and actions of living beings, under the rule of the *Bauplan*. And this is what Von Uexküll's analysis of what he terms the functional circle (*Funktionskreis*) and its various components is all about.

Ultimately, this is the method of biology: "Biology is quite different if one makes comparison the basis of the whole study."[114] (von Uexküll 1909, p. 8). He adds: "Conformity with plan is never given us directly, but is always yielded up to us. That is to say, it is our task to discover it by studying the associations in the single instance. That alone is biology" (von Uexküll 1926 p. 322).

5.A.3.3 – Conclusion: The Kaleidoscope of Life

Up until this point von Uexküll has been highlighting the immense complexity of the natural world. Nature through the eyes of physics is simply a plain world. It is a chaotic world, devoid of organization beyond the piling of elements from the inorganic world. However, this same nature, through the eyes of biology, is much richer and complex. There is an overarching

[113] Die Rezeptoren wählen unter den Wirkungen der Umgebung jene Reize aus, die nach dem Bauplan des Tieres geeignet sind, bemerkt zu werden, und geben daraufhin dem Nervensystem ein Zeichen, sobald der betreffende Reiz in der Umgebung sich geltend macht. Man kann demnach feststellen, wieviel Zeichen ein Tier von seiner *Umwelt* erhält — soviel Reize, soviel Zeichen. Hat ein Tier auf diese Weise ein Zeichen seiner *Umwelt* erhalten, so muß es darauf eine Antwort erteilen.

[114] Ganz anders nimmt sich die Biologie aus, wenn man die Vergleichung zur Grundlage des ganzen Studiums macht.

organizational law, uniting organisms and their surrounding worlds in a meaningful way. There is not a single world but an infinite variety of them. Each of these worlds is at the same time unreachable and unfathomable in itself. Yet at the same time all are bound together by the subjective experience of the observer. In von Uexküll's worlds, as we quoted above: "Physical theory tries to convince the plain man that the world he sees is full of subjective illusions, and that the only real world is much poorer, since it consists of one vast, perpetual whirl of atoms controlled by causality alone. On the other hand, the biologist tries to make the plain man realise that he sees far too little, and that the real world is much richer than he suspects, because around each living being an appearance world (*Erscheinungswelt*) of its own lies spread, which in its main features, resembles his world, but nevertheless displays so much variation therefrom that he may dedicate his whole life to the study of these other worlds without ever seeing the end of his task" (von Uexküll 1926, p. 71).

Von Uexküll's investigation led him to produce a meta-alphabet of the organization of this world. Given that we do not have a single absolute world, our knowledge of nature in itself is produced through the identification and study of all the different "points of view", the subjective worlds of the different species, that is, the different forms of representation. Ultimately, this meta-alphabet corresponds to Kant's "transcendental doctrine of elements" (N.B. to a biological version – and therefore a very particular kind – of it).

Von Uexküll's goal is to identify the variable nuclei of representation of each species. Each subjective world corresponds to a unique representation of nature. Each species contributes as a piece of the multidimensional puzzle of life. Ultimately, our own subjective experience is enriched with this enterprise: "Now as soon as we have studied even a few animals long enough to show what the surrounding world, that envelops them like a firm though invisible greenhouse, is, we are capable of filling the world around ourselves with a countless multitude of these iridescent worlds; and this [sic] enriches our own a thousandfold, however full and varied it may be. And thus it is that biology can offer the ordinary man an unlimited enlargement of his world, whereas the physicist would reduce him to beggary"[115] (von Uexküll 1928, p. 62).

[115] Haben wir nun erst einmal den Anfang gemacht, an wenigen Tieren zu zeigen, welche *Umwelt* sie wie ein festes, aber unsichtbares Glashaus umschließt, so werden wir bald die Welt um uns mit zahllosen schillernden Welten bevölkern können, die den Reichtum unserer reichen Welt noch tausendfach erhöht [sic]. So bietet die Biologie dem Naiven eine unbegrenzte Bereicherung seiner Welt, während der Physiker ihn zum Bettler macht

In the end, as the elements that compose nature in itself are gradually revealed – these "iridescent worlds" – nature shows itself as a never-ending kaleidoscope: "The universe still lies before us as an unravelled, often shivering splendour of thousands of overlapping gardens, each of which bears its [own] flowers and its [own] trees (…)"[116] (von Uexküll 1928, p. 231). In this way, von Uexküll produces a meta transcendental doctrine of life itself, whose object is the shape of all shapes viz. the *Bauplan* of *Baupläne*.

5.B – The Functional Circle

The functional circle (or function-circle) (*Funktionskreis*) is one of the most fundamental theoretical instruments introduced by von Uexküll. It is at the basis of his insights into the connection between subject and *Umwelt*. In his *Theoretical Biology* von Uexküll introduces this concept stating: "Every animal is a subject, which, in virtue of the construction type (*Bauart*) peculiar to it, selects stimuli from the general influences of the outer world (*Außenwelt*), and to these it responds in a certain way. These responses, in their turn, consist of certain effects on the outer world, and these again influence the stimuli. In this way, a self-contained periodic cycle, which we may call the functional circle of an animal, arises"[117] (von Uexküll 1928, p. 100). The functional circle is in itself composed of different sectors. It is a combination of the inner and the surrounding world of an animal.

The surrounding world (*Umwelt*) is composed of two parts: the world-as-sensed, or perceptive world (*Merkwelt*) and the world of action, or effective world (*Wirkwelt*). The perceptive world is composed of the sum of the notes received by an animal. The perceptive organs (*Merkorgan*) of the animal detect stimuli that will form notes which connect with the whole functional circle. The effective world is composed of the actions directed by the animal towards the exterior. It

[116] Noch liegt das Universum vor uns als eine unentwirrte vielfach schillernde Pracht von abertausend sich überschneidenden Gärten, von denen ein jeder seine Blüten und seine Bäume trägt (...)

[117] Jedes Tier ist ein Subjekt, das dank seiner ihm eigentümlichen Bauart aus den allgemeinen Wirkungen der Außenwelt bestimmte Reize auswählt, auf die es in bestimmter Weise antwortet. Diese Antworten bestehen wiederum in bestimmten Wirkungen auf die Außenwelt, und diese beeinflussen ihrerseits die Reize. Dadurch entsteht ein in sich geschlossener Kreislauf, den man den *Funktionskreis* des Tieres nennen kann.

refers to the world that an individual can act on through its effective organs (*Wirkorgan*) (von Uexküll 1926, p. 126-127).

The *Umwelt* is produced through the effects selected by the receptors of an organism. This shows us the unity of the subject with its *Umwelt*: the receptors are built in conformity with the *Bauplan*, so that the *Umwelt* cannot but be in conformity with plan as well. "The effects [of the outside world], whether chemical or physical, are always called stimuli [*Reize*] when one wants to express their relationships with the receptors of animals"[118] (von Uexküll 1909 p. 55). "Here it is sufficient to point out that the type of receptor each animal uses decides sovereignly with which effects of the outside world (*Außenwelt*) the animal should enter into relationships and with which not. The sum of all the stimuli that an animal receives thanks to the design of its receptors form its surrounding world."[119] (von Uexküll 1909 p. 55).

Now, as we mentioned, if a subject (an animal) is truly interacting with the *Umwelt*, the effects of the outside world should be transferred to its inner world (*Innenwelt*). "As objective as the factors of the surrounding world are, the effects they produce must be sensed in the nervous system. These effects are also seen and regulated by the building plan. Together they form the inner worlds of animals"[120] (von Uexküll 1909, p. 6). "From the effects of the environment (*Umgebung*), the receptors select those stimuli which, according to the animal's building plan, are likely to be noticed and then give a signal to its nervous system as soon as the stimulus in question takes effect in the environment"[121] (von Uexküll 1909 p. 59).

5.B.1 – *Innenwelt*

Both quotations above highlight the two components of the inner world: the nervous system regulated by the *Bauplan* – and the physiological and biological elements.

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[118] Mögen die Wirkungen chemischer oder physikalischer Art sein, immer nennt man sie, wenn man ihre Beziehungen zu den Rezeptoren der Tiere ausdrücken will, Reize.
[119] Hier genügt der Hinweis, daß die Bauart der Rezeptoren eines jeden Tieres souverän darüber entscheidet, mit welchen Wirkungen der Außenwelt das Tier Beziehungen eingehen soll, und mit welchen nicht. Die Summe aller Reize, die ein Tier dank der Bauart seiner Rezeptoren empfängt, bildet seine Umwelt.
[120] Ebenso objektiv wie die Faktoren der Umwelt sind, müssen die von ihnen hervorgerufenen Wirkungen im Nervensystem aufgefaßt werden. Diese Wirkungen sind ebenfalls durch den Bauplan gesichtet und geregelt. Sie bilden zusammen die Innenwelt der Tiere.
[121] Die Rezeptoren wählen unter den Wirkungen der Umgebung jene Reize aus, die nach dem Bauplan des Tieres geeignet sind, bemerkt zu werden, und geben daraufhin dem Nervensystem ein Zeichen, sobald der betreffende Reiz in der Umgebung sich geltend macht.

If we focus on the physiological features of its *Innenwelt*, we observe that the external stimuli reaching an animal will activate an excitation (*Erregung*) in the nervous system, eventually triggering a muscular action. “The great majority of animal movements proceed as follows: An external stimulus acts on a receptive organ, which gives the nervous system an excitation. Guided by the nervous system, the excitation finally reaches the muscle, which then shortens. This process is called a reflex”[122] (von Uexküll 1909, p. 8). Von Uexküll wrote extensively on the importance of the reflex: “All actions of animals can be traced back to reflexes. The reflex is the basic element of all actions. But this basic element already combines various factors into a common function. Each reflex is the response of a part of an animal's body to an influence from the outside world.”[123] (von Uexküll 1909, p. 54).

Here we identify the common process for the detection, propagation and reaction to stimuli among different organisms: “In its main features, the guiding apparatus is the same from the lowest animals to the highest. Wheresoever qualitatively different stimuli effect an entry, we find that their specific peculiarity is taken from them. Whether an airwave strikes the ear, or an etheric wave the retina, the same transformation is set going in both cases. A [sic] excitation is around, which passes the nerves in waves. The length and speed of these waves may vary to a certain degree, but fundamentally the process is always the same” (von Uexküll 1926, p. 147).

An animal’s physiological response to a stimulus can tell us a lot about the receptive qualities of the animal. In the physiological features of the *Innenwelt*, the stimuli are translated into a nervous excitation. Here we can see how one animal reacts to the effects of the outside world. But they only show that something is happening outside of the body of the subject. “The excitations are the only objective process, from the coming and going of which the inner life (*Innenleben*) of animals is built. In contrast to the colourful and varied environment (*Umgebung*), the inner world (*Innenwelt*) undergoes no change in quality. The dynamic excitations can only therefore be seen as a sign (*Zeichen*) that something is going on outside,

[122] Die große Mehrzahl der tierischen Bewegungen geht folgendermaßen vonstatten : Ein äußerer Reiz wirkt auf ein Rezeptionsorgan, dieses erteilt dem Nervensystem eine Erregung. Vom Nervensystem geleitet erreicht die Erregung schließlich den Muskel, der sich dann verkürzt. Diesen Vorgang nennt man einen Reflex.

[123] Alle Handlungen der Tiere sucht man auf Reflexe zurückzuführen. Der Reflex ist also das Grundelement aller Handlungen.
Aber dieses Grundelement vereinigt bereits verschiedene Faktoren zu einer gemeinsamen Funktion. Jeder Reflex ist nämlich die Antwort eines Teils des Tierkörpers auf eine Einwirkung der Außenwelt.

without having the slightest resemblance to the processes of the environment"[124] (von Uexküll 1909, p. 59). The stimuli and the physiological reaction of an animal do not tell us about its perceptual capacity. "Whosoever turns from psychology or the theory of knowledge to the physiology of the central nervous system, will meet with very great disappointment." (von Uexküll 1926, p. 146)

This information is only provided through the concept of note (*Merkmal*), which is not fully explained by the presence of stimuli. The concepts of stimuli and note apply to the same qualities, but they are not identical. We can have different stimuli producing the same response in an animal, or the same stimulus could have different responses if it reaches different receptors. (von Uexküll 1926, p. 133-135). "For the biological study of an animal, therefore, knowledge of the stimuli is not enough. Yet another factor must be sought in order to explain why the animal should give the same response. I shall call this factor an indication [note]" (von Uexküll 1926, p. 135).

Von Uexküll clarifies how biological understanding is not subsumed into the physiological, even though both depend on external stimuli. He states that the actions of organisms: "1. Do not depend on the excitations that merge indiscriminately in a perceptive network (*Merknetz*), but on notes (…) 2. These resulting notes are not transferred to the points of excitation (*Erregunstellen*) in a sensory organ, but to the source of the stimulus (*Reizquelle*)"[125] (von Uexküll 1928, p. 116).

What exactly is the note (*Merkmal*)? According to von Uexküll, the perceptive effect of the stimuli is described as a perceptive-sign (*Merkzeichen*), which is the internal factor that signifies "the alteration in the content that is just perceptible to attention"[126] (von Uexküll 1928, p. 66). These signs are internal but are revealed as the subjective world is formed in the form of the notes. A subject's world is therefore not composed of external objects brought together, but of the notes that are produced through the effects of the external world. "The sensations of the

[124] Die Erregungen sind der einzige objektive Vorgang, aus dessen Gehen und Kommen sich das Innenleben der Tiere aufbaut. Im Gegensatz zur bunten und mannigfaltigen Umgebung kennt die Innenwelt keinen Wechsel in der Qualität. Daher kann man die dynamischen Erregungen nur als Zeichen dafür betrachten, daß etwas außerhalb vorgeht, ohnn daß sie selbst die mindeste Ähnlichkeit mit den Vorgängen der Umgebung besitzen.

[125] 1. nicht von unterschiedslos in einem Merknetz zusammengeflossenen Erregungen abhängig sind, sondern von gegliederten Merkmalen die ihren Aufbau einzelnen Merkzeichen der erregten Nervenpersonen verdanken. 2. werden diese so entstandenen Merkmale nicht an die Erregungsstellen im Sinnesorgan, sondern in den Raum an die Reizquelle verlegt.

[126] (...) die eben merkliche Inhaltsänderung der Aufmerksamkeit.

mind become properties of things when the world is built, or, as one can say, the subjective qualities build up the objective world. If one puts the perceptive-sign in place of sensation or subjective quality, one can say that the perceptive-signs of our attention become notes of the world. This means that the laws holding for internal perceptive-signs must also apply to external notes. We call such immutable laws natural laws"[127] (von Uexküll 1928, p. 66).

Consequently, it is clear what von Uexküll means when he says that notes are produced by the subject. "The indication [note] is not a physiological factor like the stimulus, but a biological factor which we deduce from the animal's response. It cannot, however, be constructed from the stimuli alone, because its formation depends on the animal itself, and because it cannot be understood at all without knowledge of the means that the animal employs for that formation" (von Uexküll 1926, p. 135).

When all is said and done, the biological perspective of the *Innenwelt* is characterized by the ability to create notes, which takes into account the conformity with plan. "While the physiologist analyses it [the central nervous system] into sensory and motor apparatus, the biologist makes a corresponding division into mark-organs and action-organs. The mark-organ [perceptive organ] includes the framework + protoplasm, in so far as it serves for the creation of indications [notes]. The action-organ [effective organ] comprises framework + protoplasm, in so far as it serves for the creation of a definite movement-sequence, which we call an action" (von Uexküll 1926, p. 154).

In the analysis of the *Umwelten* of other organisms, we are looking at their reaction to external stimuli. But we must remember that we only want to analyse those effects which are translated to the *Innenwelt*. "From the construction of the sensory organs and from the reactions of the animals to external stimuli (*Reize*), we can conclude that intangible sensory signs (*Sinneszeichen*) appear"[128] (von Uexküll 1928, p. 116). However, when we consider the *Umwelten* of other organisms we must remember that we cannot enter their *Umwelt*, and thus their *Innenwelt.* Consequently: "Since we are also prevented from knowing the foreign 'perceptive-signs' (*Merkzeichen*), we are dependent on determining which properties of our

[127] 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 Stelle von Empfindung oder subjektiver Qualität das Merkzeichen, so kann man sagen, die Merkzeichen unserer Aufmerksamkeit werden zu Merkmalen der Welt. Daher müssen die Gesetze, die für die inneren Merkzeichen bindend sind, auch für die äußeren Merkmale gelten. Solche unwandelbaren Gesetze nennen wir Naturgesetze.
[128] Aus dem Bau der Sinnesorgane und aus den Reaktionen der Tiere auf äußere Reize können wir auf das Auftreten der immateriellen Sinneszeichen schließen.

appearance world (*Erscheinungswelt*) in the surrounding world of an animal are valid as 'notes'"[129] (von Uexküll 1928, p. 72). "(…) we can only examine them in their form as notes if they are moved outside"[130] (von Uexküll 1928, p. 116).

In this step of the analysis it is crucial for the observer not to think that his notes are the same as the notes of an organism. "If an observer is faced with an animal whose world he wants to examine, he must first of all be aware that the notes from which the foreign world is composed are his own notes and have not arisen from the perceptive-signs of a foreign subject that he cannot even know"[131] (von Uexküll 1928, p. 67). Consequently, "the only thing we can determine from the experiment is the number and type of notes in the perceptive world (*Merkwelt*) to which the animal responds."[132] (von Uexküll 1928, p. 69).

5.B.2 – Primary circles

As von Uexküll describes, functional circles are composed of different sectors. But, while the structure of these units is constant, it can manifest itself in animals' lives in a great variety of ways. They can be divided into biologically distinct primary functional groups: the medium, prey, enemy and sexual circles.

The medium circle is characterized by "the fact that the medium itself exerts no stimulus on the animal but, if an animal leaves the medium, a stimulus is immediately released, which causes a steering mechanism and in turn directs the animal back into the medium"[133] (von Uexküll 1928, p. 100-101). In other words, the medium has no notes for the animal to detect (like air for a bird, water for a fish), while obstructions in the medium act as notes. This means that the medium is only noticed when it is absent. A reaction in an organism provoked by the removal of its medium should indicate a relevant function in it. However, while this observation is useful, we should always remember that our analysis concerns the function itself and not just the reaction detected. On the one hand, we can confidently say that every time the removal of

[129] Da uns auch die Kenntnis der fremden „Merkzeichen" verwehrt ist, sind wir darauf angewiesen, festzustellen, welche Eigenschaften unserer Erscheinungswelt in der Umwelt eines Tieres als „Merkmale" Geltung haben.
[130] (...) wenn sie hinausverlegt sind, in ihrer Form als Merkmale untersuchen.
[131] Befindet sich ein Beobachter einem Tier gegenüber, dessen Welt er untersuchen will, so muß er sich vor allem darüber klar sein, daß die Merkmale, aus denen sich die fremde Welt zusammensetzt, seine eigenen Merkmale sind und nicht aus den Merkzeichen des fremden Subjekts entstanden sind, die er gar nicht kennen kann.
[132] Das einzige, was wir durch das Experiment feststellen können, ist die Zahl und Art der Merkmale in der Merkwelt, auf die das Tier reagiert.
[133] (...) daß das Medium selbst kein Reiz auf das Tier ausübt, daß dagegen das Verlassen des Mediums sofort reizauslösend wirkt, der eine Steuerung veranlaßt und das Tier wiederum in das Medium zurücklenkt.

the medium triggers a reaction in an organism, that reaction corresponds to a function of that organism. Yet, the reverse is not necessarily true: if the removal of the medium does not trigger a reaction, we cannot conclude that a corresponding function in the organism does not exist.

Besides the medium circle we find the prey (or food) circle: "(…) the animal receives a stimulus proceeding from the notes of the food (be it of animal or vegetable nature) (…)"[134] (von Uexküll 1928, p. 101). In this case, the animal moves towards the notes and when it reaches the food, new notes activate its masticatory systems. In the enemy circle, the process is the same but, in this case, the note either drives the animal away from the stimulus or activates its defensive mechanism. Here the notes are normally from another animal. The sexual circle works in a way similar to the food circle. Only in this case, the notes guide the activity of the sexual apparatus (von Uexküll 1928, p. 101-102).

5.B.3 – The Working of the Functional Circle

Figure 6

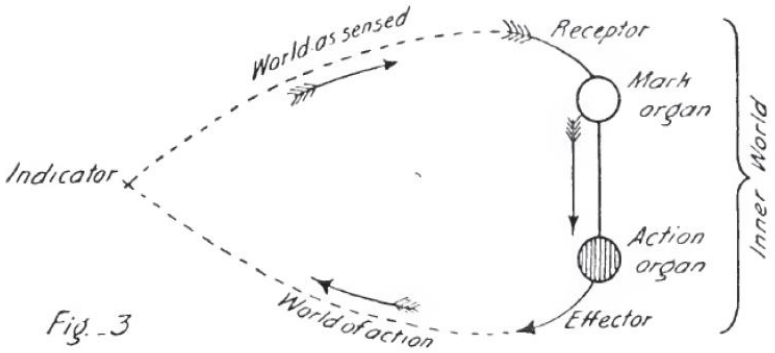

Figure 6 – Functional circle of organisms (adapted from von Uexküll 1926, p. 155)

The figure shows a simple diagram of the functional circle. As described above, the inner world is composed of two parts: The perceptive organ (*Merkorgan*) and the effective organ (*Wirkorgan*). The working of the functional circle is provided by the functional rule, the factor that we introduced in the previous sections. "Every time an indication [note] appears, a function-rule lies behind it and comes to expression in the structure as well as in the activity of

[134] (...) das Tier einen Reiz, der von den Merkmalen der Nahrung (sei sie pflanzlicher oder animalischer Art) (...) ausgeht (...)

the mark-organ [perceptive organ]. In the same way, a function-rule lies behind every action, and finds expression in the structure and the activity of the action-organ [effective organ]" (von Uexküll 1926, p. 154). We have, thus, the functional rule expressed in the form of a perception-rule (in the activity of the perceptive organ) and an action-rule (in the effective organ).

The perceptive organ is turned towards the perceptive world (*Merkwelt*) and its specific rule organizes the impressions that it receives in this organ and creates the notes. The effective organ is directed towards the effective world and its rule arranges the effects produced by this organ and creates actions. In the functional circle, the rules of both the perceptual and effector organs are focused on the external world, incorporating it from both sides to form a unified whole. As we saw for the different types of functional circle, the receptors detect the manifestation of the different types of notes and the effectors deal with them accordingly (von Uexküll 1926, p. 155-156).

Animals that have the same effective world (*Wirkwelt*) do not necessarily have the same perceptive world (*Merkwelt*). The perception of the same object can happen in a completely different way between two animals sharing the same operating world (von Uexküll 1913b, p. 65). As mentioned above, we can observe, for example, animals that have locomotion organs perfectly adapted to their medium, while, at the same time, not being aware of that medium.

5.B.4 – Forming Type 2 Objects

The working of the functional circle could be summarized in a few words: "Every animal is a subject, which, in virtue of the structure peculiar to it, selects stimuli from the general influences of the outer world and responds to them in a certain way. These responses, in their turn, consist of certain effects on the outer world, and these effects again influence the stimuli. In this way a self-contained periodic cycle, which we may call the functional circle of the animal, arises"[135] (von Uexküll 1928, p. 100). What exactly is behind the stimuli that the organism receives from the environment?

[135] Jedes Tier ist ein Subjekt, das dank seiner ihm eigentümlichen Bauart aus den allgemeinen Wirkungen der Außenwelt bestimmte Reize auswählt, auf die es in bestimmter Weise antwortet. Diese Antworten bestehen wiederum in bestimmten Wirkungen auf die Außenwelt, und diese beeinflussen ihrerseits die Reize. Dadurch entsteht ein in sich geschlossener Kreislauf, den man den Funktionskreis des Tieres nennen kann.

It is helpful to recall the categories that we introduced above. We mentioned how von Uexküll considers three levels in the analysis of objects. First, we have what von Uexküll calls "things" (*Dinge*), characterized by their properties: matter in repose, organized in space. On a second level, we find type 1 objects (*Objekte*), which constitute the inorganic matter, ruled only by the laws of causality. The spatial arrangement of type 1 objects is provided only by the structure (*Struktur*) of the substance that composes them. On a third level, the law of conformity with plan is included and we have type 2 objects (*Gegenstände*), possessing a framework (*Gefüge*) which, as we saw, expresses the *Bauplan*.

How, therefore, does the function-circle explain the origin of these type 2 objects in conformity with plan? As we mentioned in a previous section, when we talk about the *Bauplan*, we do not only mean the organization of the parts in space but also a functional plan. In the example of the ladder, it is only through the recognition of the act of climbing, together with its spatial organization, that the different components are ordered into a whole. The full significance of a type 2 object is therefore only obtained by knowing its function (von Uexküll 1926, p. 106). Von Uexküll supports this explanation by sharply observing that, in fact, the names we usually give to objects reflect their functionality: "A bench, for instance, may be called a 'settle'; and in the word 'steps' for 'stairs' the function is clearly expressed" (von Uexküll 1926, p. 107). In sum: "Instead of conformity with plan (*Planmäßigkeit*) expressed by a type 2 object, we may therefore speak of its 'conformity with function' (*Funktionsmäßigkeit*)"[136] (von Uexküll 1928 p. 86). We can therefore talk about a functional framework. This means that not only the organization in accordance with plan of a type 2 object has to be provided, but also its functionality. We find that, as an object enters the *Umwelt* of an organism, as it becomes a note, it acquires functionality.

Figure 7

[136] Wir können daher auch statt von der Planmäßigkeit eines Gegenstandes von seiner „Funktionsmäßigkeit" sprechen.

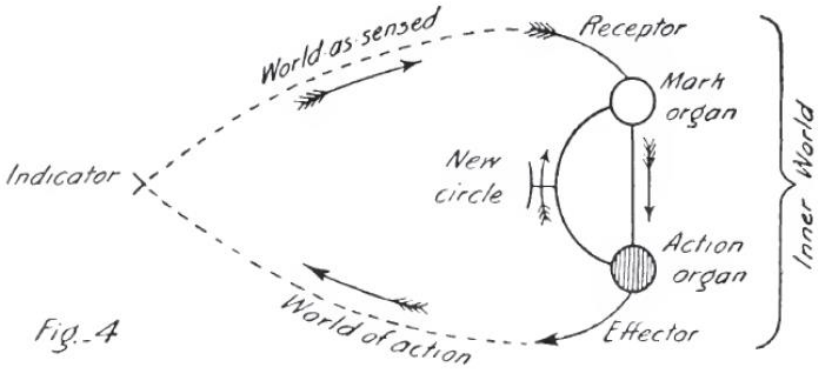

Figure 7 – Functional Circle of organisms (adapted from von Uexküll 1926, p. 157)

In most functions of organisms, the action-rule is only detected when the action takes place. But in higher animals, the action-rule enters progressively into the world-as-sensed viz. perceptive world (*Merkwelt*). As shown in the figure, the action organ viz effective organ, connects to the mark organ viz. receptor organ. This creates a new circle, meaning that the action-rule (from the effective organ) assumes the direction and control of the mark organ. (von Uexküll 1926, p. 157). Accordingly, "(…) an implement [type 2 object] appears in the world-as-sensed only when the rule governing the course of the activity in the action-organ affects the mark-organ in some way, and there forms the basis around which the indications [notes] arrange themselves" (von Uexküll 1926, p. 234).Type 2 objects can thus be produced by the functional rule (von Uexküll 1926, p. 143).

We mentioned that objects (*Objekte*) are extended in space and time, characterized by their properties and capacities, subject only to the law of causality. In higher animals, type 2 objects appear in the perceptual world when a subject's action-rule provides them with a function: "This action-rule combines all the properties and capacities in such a conformity with plan that they are obliged to obey an inner rule, which we call the function-rule of implements [type 2 objects]. So we human beings transfer our own function-rule to implements [type 2 objects], just as we transfer to them the indications [notes] we ourselves have formed" (von Uexküll 1926, p. 157). Von Uexküll summarizes: "In this way, one's own action-rule (*Handslugsregel*) fits into the externally stimulated notes (*Merkmalen*) and now serves as a framework (*Gerippe*) for the perceptive-rule (*Merkregel*) to which it attaches the external notes. Only now do real type 2

objects arise in the perceptive world (*Merkwelt*) that have a functional rule."[137] (von Uexküll 1928, p. 133).[138]

5.B.5 – Machines in the Human *Umwelt*

The human action-rule extends towards the object creating real type 2 objects, which are thus, via a functional rule, attributed a function fixed in the framework, which is the externally visible expression of that rule (von Uexküll 1926, p. 178). "Unlike what happens in the majority of animals, the sensed-world of the human being also embraces his effector-organs and their activity. So it is possible to form real implements [type 2 objects] based on a human action-rule, around which certain properties arrange themselves under compulsion by the schema" (von Uexküll 1926, p. 333).

In a previous section we mentioned how in the case of machines the conformity with plan was provided by their creator. The builder draws up the plan of the machine and combines the different parts according to that plan. Through the functional rule of the creator, the different components are arranged into a framework, which is responsible for carrying out the action that follows that functional rule (von Uexküll 1926, p. 178). Both the organizational plan and functional plan are provided by the external agency of the builder. The machine-organism analogy therefore starts by recognizing that both organisms and machines have a framework but it does not account for the differences in their origins: "Indeed it is possible, up to a certain point, to imagine machines possessing a stimulus-rule (*Reizregel*) and a movement-rule (*Bewegungsregel*), as though they were animals, even if they do not have a perception-rule (*Merkregel*). But such rules are not capable of any change, for machines consist entirely of a fixed framework and all the rules that can be deduced from their spatial structure and their functions are human rules; these do not belong to the machines, but are introduced into them from without. Consequently, they can be altered only from without, through human intervention"[139] (von Uexküll 1928, p. 146).

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[137] Auf diese Weise fügt sich die eigene Handlungsregel den von außen angeregten Merkmalen ein und dient nun der Merkregel als Gerippe, an die sie die äußeren Merkmale angliedert. Nun erst entstehen in der Merkwelt wirkliche Gegenstände, die eine Funktionsregel besitzen. Bei den einfacheren Tieren waren nur Objekte in der Merkwelt vorhanden.

[138] In this sense, the functional rule describes the active action-rule, that is, not only the existence of the required "instruments" for some action, but the concrete realisation of those conditions.

[139] Ja, es ist bis zu einem bestimmten Punkt möglich, sich Maschinen vorzustellen, die wie die Tiere, wenn auch keine Merkregel, so doch eine Reizregel und eine Bewegungsregel besitzen. Nur sind diese keiner Wandlung fähig, weil die Maschinen ausschließlich aus einem festen Gefüge bestehen und alle Regeln, die man aus ihrem

The extension of the functional rule of the constructor towards the machines highlights how these cannot be understood apart from the human *Umwelt*: "The outer world (*Außenwelt*) of our machines, which are all nothing but continuations of our human organs, is therefore never anything but a part of our human world"[140] (von Uexküll 1928, p. 105).

5.B.6 – Closing the Circle: Counter-Framework

We saw above how a type 2 object is characterized by being in accordance with plan. This means that its organization does not come simply from the structure of its components (as is the case of a type 1 object), but from its organization in conformity with plan, that is, its framework (*Gefüge*). However, the full significance of a type 2 object is not obtained only by knowing its organizational plan, but also by knowing its functional one. We saw that machines (as type 2 objects) are conferred functionality by the functional rule of the builder, as they enter into the *Umwelt*. That is, they are associated with some human action: "All our utensils and machines are no more than aids for human beings"[141] (von Uexküll 1956, p. 21). This means that, inside the function-circle, a machine connects to a certain action of the subject, that is, it possesses what von Uexküll calls a counter-action: "Hitherto we have considered only our unified tools (such as, for instance, the ladder), and shown that they have a framework constructed in accordance with a function-rule, which fits them for a counter-action in support of our human activities – in this case the act of climbing" (von Uexküll 1926, p. 159).

The functional circle thus becomes a closed circle: in an object we find a connection both to the perceptive world and to the effective world. These components are expressed in the object's counter-framework (*Gegengefüge*).

räumlichen Bau und ihren Funktionen ableiten kann, menschliche Regeln sind, die nicht ihnen angehören, sondern von außen in sie· hineingetragen sind. Daher können diese Regeln .auch nur von außen her durch Eingriffe des Menschen abgeändert werden.

[140] Die Außenwelt unserer Maschinen, die samt und sonders nichts anderes sind als Fortsetzungen unserer menschlichen Organe, ist daher nie etwas anderes als ein Ausschnitt unserer menschlichen Welt.

[141] Alle unsere Gebrauchsgegenstände und Maschinen sind nichts anderes als Hilfsmittel des Menschen.

Figure 8

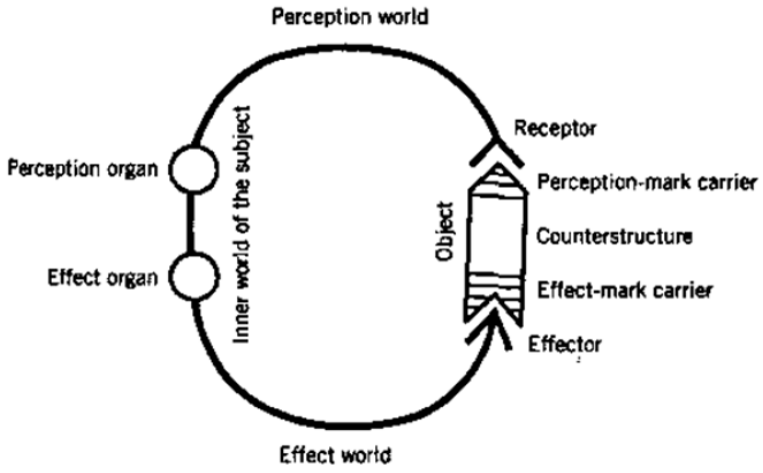

Figure 8 – The counter-framework (*Gegengefüge*) (translated in the figure as counterstructure) in the functional structure (adapted *from von Uexküll 2010, p. 49). Note: to be consistent with the terminology used in previous sections we will use different translations. In the figure we see the terms "Perception-mark carrier" and "Effect-mark carrier". These correspond to the original terms: Merkmalträger and Wirkmalträger, respectively. These will be translated as: "carrier of note-properties" and "carrier of action-properties", respectively.*

The diagram above shows how the indicator (object) has what von Uexküll calls a counter-framework (*Gegengefüge*): on the one hand, through the notes, the object forms a special unity with the receptors, and, on the other hand, it also connects with the effectors, if these come into action. In the counter-framework, given that one part enters in relation with the receptors of the subject and the other with the effectors, we can identify the carrier of note-properties (*Merkmalträger*) and the carrier of action-properties (*Wirkmalträger*), respectively. (von Uexküll 1926, p.170-173).

The whole functional rule is thus a unit, with the perceptive world (*Merkwelt*) and operative world (*Wirkwelt*) connected on both sides. On the one hand, in the framework of a subject: "The effects that pass from the carriers of note-properties (*Merkmalträger*) to the receptors play out in the subject's 'perceptive world'. The effects of the effectors on the carrier of action-properties (*Wirkmalträger*) of the object play out in the 'effector world' of the

subject"[142] (von Uexküll 1928, p. 106). On the other hand, in the counter-framework of the object: "in all surrounding worlds whatsoever, the carrier of note-properties and the carrier of action-properties of a function-rule are held together by the counter-framework of the same object" (von Uexküll 1926, p. 174). The functional circle thus closes on itself: "carriers of note-properties (*Merkmalträger*) and carrier of action-properties (*Wirkmalträger*) are held together by the counter-structure of the object, which completes the functional cycle."[143] (von Uexküll 1928, p. 105-106).

5.C – *Fügung*

We have already analysed how the different parts of an organism compose a whole through an organization according to a plan, expressed in the framework. "The framework rule (*Gefügeregel*) in the permanent anatomical framework (*Gefüge*) is so obvious that one does not need to go into it any further"[144] (von Uexküll 1928, p. 135). Now the analysis of the functional circle has shown how a subject is connected to its environment through various types of interaction: medium, food, prey etc. The analysis above highlighted what we developed at the start of this chapter: the organism-*Umwelt* unity: "(…) a subject and an object do not exist separately but in a relationship to each other. A scientist investigates this relationship, that is, the behaviour of living organisms in their being directed towards the external world, and on this basis draws conclusions about objects specific for a given subject" (Pobojewska 2001, p. 329). As Heidegger mentioned, Driesch is thus the first to go beyond a purely mechanical reductionist analysis of organisms and focus on their wholeness. But it is von Uexküll that builds on this concept and highlights how the understanding of an organism is inherently connected to the understanding of its environment (Buchanan 2008, p. 52).

This means, as we have seen, that the *Bauplan* of organisms also extends beyond their body: "(…) an animal and its environment constitute a functional unity determined by the

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[142] Die Wirkungen, die von den Merkmalträgern zu den Rezeptoren übergehen, spielen sich in der „Merkwelt" des Subjektes ab. Die Wirkungen der Effektoren auf die Wirkmalträger des Objektes spielen in der „Wirkwelt" des Subjektes. Die Übertragung der Wirkungen von den Rezeptoren auf die Effektoren vollzieht sich in der „Innenwelt" des Subjektes.

[143] Merkmalträger und Wirkmalträger werden durch das Gegengefüge des Objektes zusammengehalten, das den Funktionskreis abschließt.

[144] Es ist die Gefügeregel im dauernden anatomischen Gefüge so offenkundig gegeben, daß man nicht weiter auf sie einzugehen braucht.

building-plan" (Brentari 2015, p. 76). And in the functional circle all its parts are in conformity with plan: "The whole functional circle entwines the inner world and surrounding world, constitutes a whole which is built in conformity with plan, where each part is compensated on the other, and nothing is left over to chance"[145] (von Uexküll 1928, p. 100). Von Uexküll uses the example of building a locomotive. In this case, we should not only build its main components, but "we must also consider the surrounding world, i.e. in this case, build the track as in conformity with plan as the locomotive itself. Animals are now built into nature in such a way that the surrounding world works like a part of the whole, in conformity with plan"[146] (von Uexküll 1928, p. 102).

With the introduction of the intrinsic organism-*Umwelt* unity the study of *Planmässigkeit* is therefore expanded: "On the one hand, each organism is built in conformity with an end in itself, and on the other hand, the organism is adapted in conformity with an end vis-à-vis its surroundings"[147] (von Uexküll 1913a, p. 192). This means that the *Umwelt* becomes an integral part of our analysis of *Planmässigkeit*: "The biological handling of the functional circles demands that we also look at the part of the circle that extends outside the body into the surrounding world (*Umwelt*) from the point of view of conformity with plan (*Planmässigkeit*). And this is new and unfamiliar to us. We are used to treating things outside a subject purely according to causality rules. However, this does not do justice to the biological framework that extends through the entire circle"[148] (von Uexküll 1928, p. 102).

We saw that the framework (*Gefüge*) shows the connection of the parts of the organism into a whole in conformity with plan. Its role in the natural processes is expressed in the form of rules. Consequently, if the *Bauplan* is expanded beyond the body of the organism, what kind of connection is there between a subject and the objects of its world? Von Uexküll calls it inter-

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[145] Der ganze Funktionskreis, der Innenwelt und Umwelt umschlingt (die wiederum in Wirkwelt und Merkwelt zerfällt), bildet ein planmäßig gebautes Ganzes, indem jeder Teil zum anderen gehört und nichts dem Zufall überlassen bleibt.

[146] (...) so müssen wir auch die Umwelt, d. h. in diesem Falle den Schienenstrang ebenso planmäßig bauen wie die Lokomotive selbst. Die Tiere sind nun derart in die Natur hineingebaut, daß auch die Umwelt wie ein planmäßiger Teil des Ganzen arbeitet.

[147] (...) einmal ist jeder Organismus in sich selbst zweckmäßig gebaut und zweitens ist der Organismus zweckmäßig in seine Umgebung eingepaßt.

[148] Die biologische Behandlung der Funktionskreise verlangt, daß wir auch den außerhalb des Körpers in der Umwelt verlaufenden Teil des Kreises gleichfalls unter dem Gesichtspunkte der Planmäßigkeit betrachten. Und dies ist uns neu und ungewohnt. Wir sind gewohnt, die außerhalb des Subjekts liegenden Dinge rein nach Kausalitätsregeln zu behandeln. Dadurch werden wir aber dem biologischen Gefüge nicht gerecht, das sich durch den ganzen Kreis hindurch erstreckt.

adjustment (*Fügung*): "If we want to describe the connection according to plan between different objects that are not permanently physically connected with each other with a special word, we will speak of inter-adjustment. In contrast to framework (*Gefüge*), which designates a permanent functional connection according to a rule, inter-adjustment means a functional connection that only occurs temporarily and is also subject to a rule"[149] (von Uexküll 1928, p. 135). A temporary framework gets produced here and also works according to a rule: "(…) the rule of inter-adjustment (*Fügung*sregel) must be sought, while the effectors form a temporary framework in their dealings with the outside world (*Außenwelt*)"[150] (von Uexküll 1928, p. 135). Von Uexküll adds that this inter-adjustment is always perfect, meaning that an organism is never more or less adapted to the surrounding world. He calls this "fittingness" (*Einpassung*): "Fittingness is always perfect, so far as the means at the disposal of the animal extend. If all organisms fit perfectly with their surrounding world, there is no such thing as gradual attainment of perfection; the perfection of fittingness exists everywhere from the very beginning"[151] (von Uexküll 1928, p. 217). In Cassirer's words: "Every organism, even the lowest, is not only in a vague sense adapted to (*angepasst*) but entirely fitted into (*eingepasst*) its environment." (Cassirer 1944, p. 24)

In summary: "Each organism is then no longer an impression of the universe, but, like any machine, is inserted in a perfectly definite circle of activity and congruous [fitting] with the objects, implements [type 2 objects] and organisms of its surrounding-world [*Umwelt*]" (von Uexküll 1926, p. 321).

5.D – Conclusion

[149] Wollen wir den planmäßigen Zusammenhang zwischen verschiedenen Gegenständen, die nicht dauernd körperlich verbunden sind, mit einem besonderen Wort bezeichnen, so werden wir von Fügung sprechen. Im Gegensatz zum Gefüge, das einen dauernden funktionellen Zusammenhang nach einer Kegel bezeichnet, bedeutet Fügung einen nur zeitweilig auftretenden funktionellen Zusammenhang, der gleichfalls einer Regel unterworfen ist.

[150] Dagegen muß die Fügungsregel aufgesucht werden, während die Effektoren bei ihrem Handeln mit den Dingen der Außenwelt ein zeitweiliges Gefüge bilden.

[151] Die Einpassung ist immer vollkommen, soweit die dem Tier zur Verfügung stehenden Mittel reichen. Wenn alle Lebewesen vollkommen in ihre Umwelt eingepaßt sind, so gibt es keine allmähliche Vervollkommnung, sondern die Vollkommenheit der Einpassung ist überall von vornherein vorhanden.

The idea of a perfect fitting between an organism and its *Umwelt* highlights a) that all events in this unit take place in accordance with a plan, and b) the decisiveness of this subjective law: "As long as it has all of its mechanical and chemical properties, every living being is suited to its surrounding world, in perfect conformity with plan. This is the end of the doctrine that denies the conformity with plan in nature"[152] (von Uexküll 1928, p. 217). This is exactly one of von Uexküll's main objectives: "If by biology we understand the doctrine of conformity with plan in the world of living things, we shall realise that one of the fundamental inquiries of the science must be into the nature of this conformity" (von Uexküll 1926, p. 270).

Now, what have we learned so far?

In Chapter 4 we tried to understand how the *Bauplan* explains the natural processes in the life of an organism. We started by referring how the *Bauplan* expresses both the spatial and functional plans of organisms and machines. Then, we saw how it informs the morphogenesis and functioning of organisms. These are built in conformity with plan through the action of the impulses on protoplasm, which directs morphogenesis. Gradually, the framework of organisms is built, maintaining the expression of this rule, according to a plan.

In this chapter, we looked into the concept of *Umwelt* in von Uexküll's views, in order to have a more complete understanding of the nature of the *Bauplan*, and consequently of *Planmässigkeit*. We introduced the ideas at the basis of von Uexküll's biological theory.

First, as Heidegger mentioned, a subject is intrinsically connected with its world. But, more than that: each subject creates its own world – appearance is entirely subjective. This change of perspective also leads to a transformation in the understanding of the *scala naturae* in the broader sense: von Uexküll's focus is chiefly on the shift from "*esse*" to "*vivere-percipere*" (the latter understood as a single category). He does not analyse each shift uniformly.

Second, we analysed the organism-*Umwelt* unity and its status of *totality*. According to von Uexküll, it is a totality not as we might usually conceive of one, but it is a particular kind of "total totality" i.e. a *particular kind* of a *totum quod non est pars alterius* (a whole which is not part of another). In other words, the organism-*Umwelt* unity encompasses everything. There is nothing "beyond" it.

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[152] Ein jedes Lebewesen ist, solange es seine sämtlichen mechanischen und chemischen Eigenschaften besitzt, in seine Umwelt mit vollkommener Planmäßigkeit eingefügt. Damit ist zunächst die Lehre, die die Planmäßigkeit in der Natur leugnet, erledigt.

Finally we concluded that not only are organisms built in conformity with plan in themselves, but also in conformity with plan with their surroundings: "Now animals are so much part and parcel of Nature that even the surrounding world works within the whole like a part constructed in conformity with plan."[153] (von Uexküll 1928, p. 102). This reinforces the notion that organism and its *Umwelt* are intrinsically connected: "The law that connects each subject to its environment cannot be grasped by mere causality but can only be interpreted as in conformity with plan. (…) It is therefore irrelevant from which point one looks at a whole in conformity with plan. Everything in it must interact. We can therefore begin to examine subjects as well as their surrounding world. One cannot exist without the other"[154] (von Uexküll 1928, p. 62).

What does this interaction tell us about the nature of the *Bauplan*? It shows that understanding the relational structure between subject and *Umwelt* corresponds to the study of the *Bauplan.* We saw that the *Umwelt* of an organism is "mutually dependent on the building plan of the animal"[155] (von Uexküll 1909, p. 5). In other words: "Every varying individual is different according to his changed building plan, but at the same time fully adapted to his environment (*Umgebung*). Because the building plan automatically creates within wide limits the surrounding world (*Umwelt*) of the animal. This realization, which I intend to prove step by step, can be regarded as the sole basis of biology. Only through it do we gain a proper understanding of how sentient beings organize and control the chaos of the inorganic world."[156] (von Uexküll 1909, p. 5).

In summary, according to Brentari, the connection between a subject and the *Umwelt* further emphasizes the importance of the *Bauplan*: "(…) the configuration in which organism and environment are integrated is teleologically directed by the building-plan, which thus ends

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[153] Die Tiere sind nun derart in die Natur hineingebaut, daß auch die Umwelt wie ein planmäßiger Teil des Ganzen arbeitet.

[154] Die Gesetzmäßigkeit, die ein jedes Subjekt mit seiner Umwelt verbindet, kann nicht durch bloße Kausalität erfaßt, sondern nur als Planmäßigkeit gedeutet werden. (...) Deshalb ist es gleichgültig, von welchem Punkte man bei Betrachtung eines planmäßigen Ganzen ausgeht. Alles in ihm muß in Wechselwirkung zueinander stehen. Wir können daher sowohl mit der Untersuchung der Subjekte wie mir der Untersuchung ihrer Umwelten beginnen. Eines wird ohne das andere nicht bestehen können.

[155] die sich mit dem Bauplan des Tieres wechselseitig bedingt.

[156] Jedes variierende Individuum ist entsprechend seinem veränderten Bauplan anders, aber gleich vollkommen seiner Umgebung angepaßt. Denn der Bauplan schafft in weiten Grenzen selbsttätig die Umwelt des Tieres. Diese Erkenntnis, die ich Schritt für Schritt zu beweisen gedenke, kann allein als dauernde Grundlage der Biologie angesehen werden. Nur durch sie gewinnen wir das richtige Verständnis dafür, wie die Lebewesen das Chaos der anorganischen Welt ordnen und beherrschen.

up governing the entire ecology of the species." (Brentari 2015, p. 78). In von Uexküll's words: "We may assume 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"[157] (von Uexküll 1928, p. 102).

[157] Man kann das folgendermaßen ausdrücken: Wo ein Fuß ist, da ist auch ein Weg. Wo ein Mund ist, da ist auch Nahrung. Wo eine Waffe ist, da ist auch ein Feind.

These lines are most likely an allusion to Cuvier's famous description of the intrinsic connection between all different parts of an animal: "En un mot, la forme de la dent entraîne la forme du condyle; celle de l'omoplate celle des ongles, tout comme l'équation d'une courbe entraîne toutes ses propriétés; et de même qu'en prenant chaque propriété séparément pour base d'une équation particulière, on retrouveroit, et l'équation ordinaire et toutes les autres propriétés quelconques, de même l'ongle, l'omoplate, le condyle, le fémur, et tous les autres os pris chacun séparément donnent la dent ou se donnent réciproquement; et en commençant par chacun d'eux, celui qui posséderoit rationnellement les lois de l'économie organique, pourroit refaire tout l'animal." (Cuvier 1821, p. 47, see also Cuvier 1828, p. 97s.)-

Cuvier's wording, when he speaks of something similar to an *equation of a curve* (and of the fact that an *equation of a curve* implies all of its properties), says it all: this is precisely what von Uexküll's unit between organism and *Umwelt* – viz. the *Baupla*n in the von Uexküllian sense of the word – is all about. The *Bauplan* is for each species (for each unit between organism and *Umwelt*) what the equation of a curve is for the curve in question.

But it should also be borne in mind that there are two important differences between Cuvier's and von Uexküll's views on this matter. First, Cuvier is referring to the anatomical and physiological totality of a given species, while von Uexküll is talking about the *animal-Umwelt unity*. Secondly, even if this first difference is taken into account, one can still understand von Uexküll's *animal-Umwelt unity* as part of a larger whole (as a *totum quod est pars alterius*). But this is not what von Uexküll has in mind. As pointed out above, in his view the *animal-Umwelt unity* viz. the *Bauplan*, is not just part of a larger whole: it is rather – for each species – nothing less than the *subjective world*: the *totum quod non est pars alterius*. In short, to put it in Cuvier's terms, von Uexküll's *Bauplan* is no less than the "equation of the curve" of the *totum quod non est pars alterius:* the "equations of the curves" of the world – or rather of the *scattered* worlds corresponding to all the different species.

Part 2

Chapter 6 – Re-Introduction

Before we move on with the comparison between the ideas of Hans Driesch and Jacob von Uexküll, let us briefly recapitulate how these two authors are usually compared.

In the previous chapters we analysed some of the main ideas of both of them. As a common starting point, both criticized the mechanistic perspective of life. We have extensively described how Driesch did not accept the materialist explanation of the phenomena of life and sought to refute it through his experiments. Von Uexküll clearly rejected this reductionist view stating: "With living beings we have to consider objects for whose existence material causes are not enough, but that require another extra-material cause. They form the solid wall, visible from afar, which resists with an emphatic 'no' the statement of materialism that everything has originated from material forces"[158] (von Uexküll 1913a, p. 126). According to von Uexküll, this is the approach of physiology, which only considers material and causal explanations. But this is not that of biology: "There is only dead matter and forces! This is a statement that a biologist who has studied the development of animals cannot accept"[159] (von Uexküll 1913a, p. 253).

In fact, "along with the physiologist Rudolf Magnus, these three men formed a little clique that worked together aggressively at scientific meetings to undermine mechanistic principles in the life sciences" (Harrington, 1996, p. 39). Both von Uexküll and Driesch agree that natural processes like the morphogenesis and physiology of organisms cannot be explained only in a physico-chemical way. There has to be some kind of purposiveness in the natural processes of organisms. We saw how, through embryological experiments, Driesch consolidated his defence of teleology against materialism: "In 1893 (…) I myself came clearly to see that teleology is an irreducible peculiarity of the phenomena of life. Critical analysis of physiological and morphogenetic phenomena led me to this conclusion." (Driesch 1914, p. 176). Similarly, as mentioned above , von Uexküll distinguishes between physiology and

[158] In den Lebewesen haben wir Gegenstände zu erblicken, für deren Existenz die materiellen Ursachen nicht ausreichen, sondern die eine andere außermaterielle Ursache verlangen. Sie bilden die feste, weithin sichtbare Mauer, die der Behauptung des Materialismus, daß alles durch materielle Kräfte entstünde, ein entschiedenes „Nein" entgegenstellt.

[159] Es gibt nur tote Stoffe und Kräfte! Dieses ist die Behauptung, die der Biologe, der die individuelle Entwicklung der Tiere studiert hat, nicht hingehen lassen darf.

biology: “Biology could not be fully suppressed by physiological chemistry, because even the most hardened chemist has to admit that every living being is not just something mechanical, but is at the very least a machine; it cannot be just something structured, but must have a structure in conformity with plan – it is not just something organic, but an organism.”[160] (von Uexküll 1905, p. 4).

As previously discussed, this common step means that von Uexküll and Driesch are usually historically paired up as supporters of the early 20th century re-emergence of vitalism, under the name of neo-vitalism. Is this opinion justified in light of the ideas of both authors?

As regards Driesch, as we will see below, the appeal to the concept of Entelechy, as the regulative force of morphogenesis, coupled with his metaphysical claims are the main justification for a neo-vitalistic perspective: “In Germany and elsewhere, a range of scientists had begun to argue for an outright rejection of the model of the machine in the life sciences. The hope that the study of life could be pursued using concepts out of the physical sciences must be abandoned, they said; new theoretical assumptions must be developed to guide research into living processes. The most influential contemporary spokesperson for this position was Uexküll's friend, Hans Driesch” (Harrington 1996, p. 48). In the Introduction we mentioned how there is a longstanding consensus that Driesch is one of the flagbearers of neo-vitalism.

Von Uexküll’s case, however, is not so clear-cut. As we mentioned in the Introduction, some authors point out the similarities of his ideas to the neo-vitalistic ones: “Physiologist Jakob J. Von Uexküll and psychologist Kurt Goldstein were but two of the most prominent promotors of the view that to explain organisms one needed to invoke anti-mechanistic final causes; like Russell, they dressed the ancient Aristotelian notion of teleology in twentieth-century scientific terminology.” (Peterson 2017, p. 35). Yet, while von Uexküll values the neo-vitalist approach, he still points out its limitations. And, as pointed out above, not all subsequent authors considered von Uexküll a vitalist: “Uexküll makes it very clear that he (…) does not identify himself as a vitalist (despite his sympathy towards this view)” (Kull 2001, p. 6). Others even add that: “(…) Uexküll's son, the psychosomaticist Thure von Uexküll, repeatedly denied that his father was a vitalist and was highly critical of the historical judgment that would set his

[160] In der physiologischen Chemie konnte die Biologie nicht völlig unterdrückt werden weil selbst der eingefleischteste Chemiker zugeben muss, dass alles Lebendige – nicht bloss etwas Maschinelles, sondern zum wenigsten eine Maschine ist – nicht bloss etwas Strukturiertes sein kann, sondern eine planmässige Struktur besitzen muss – nicht bloss etwas Organiches, sondern ein Organismus ist.

father in the same camp as such self-proclaimed neo-vitalists as Hans Driesch (Harrington 1996, p. 52, footnote).

Driesch's Entelechy is more easily defined as a vitalistic concept. Von Uexküll's ideas, however, are not easily categorized. So, what is von Uexküll's position? In chapters 4 and 5 we already had a glimpse of the solution. We saw how he appears to reject both vitalism and mechanicism. Instead he defends an intermediate view, which he calls the "machinalist" view (von Uexküll 1913b, p. 27). It claims that the functioning of the organs can be understood as analogous to the functioning of machines, even though these processes can only be fully understood within a teleological framework. In von Uexküll's case, this teleological factor is conformity with a plan (*Planmässigkeit*), specifically, the *Bauplan*.

In the following pages, we propose a way to make sense of this question. Specifically: is von Uexküll a vitalist like Driesch? In order to answer this question, we need to work through several stages. First, we need to take a deeper look into the transition of Driesch's views from a static to a dynamic teleology, now with special attention to the dynamic factor introduced. What is its nature and its properties? How does it act on organisms? Secondly, we need to see if in von Uexküll's ideas we can find a similar factor beyond the *Bauplan*. This requires that we look with more detail into the nature of the *Bauplan* and other elements, some of which we have already introduced. Lastly, we have to compare the nature of the Uexküllian factors with Driesch's dynamic factor, and also compare the ontological and epistemological claims made by each author. Only then can we produce a verdict. In short, we specifically need to focus on the teleological positions of each author so that we can then compare them. This is our general goal.

In this final section we will start by returning to Driesch's ideas. In chapters 2 and 3 we saw how Driesch finds the reductionist approach insufficient, indicating that something else is required. What is the positive alternative? We will see that next.

Chapter 7 – Driesch: Entelechy

7.A – Recapitulating: Machine-Theory to Entelechy

As we mentioned in Chapter 2, Driesch defends the existence of purposiveness, or teleology, over the causal-mechanical explanation of natural phenomena. During that Chapter, and then during Chapter 3, we navigated Driesch's path in the quest to understand the characteristics of this purposiveness.

First, Driesch argues for the existence of some form of teleology in the living world. He uses the term "descriptive purposiveness, or teleology" to simply point out the difference from the mechanistic perspective: "It will be seen that we must first decide about the ultimate laws of phenomena which we have hitherto described only analogically in a more external manner, for it cannot be too often repeated that the mere assertion of purposiveness, mere teleology, to use the general technical expression, is purely descriptive. The term descriptive teleology will therefore be used definitely throughout the whole of this book to designate every descriptive view which deals simply with the existence of purposiveness." (Driesch 1914a, p.5).

With the first stage of the argument Driesch is not trying to select between the two main types of teleology, which we have already introduced, but only to point out the existence of some form of purposiveness: "if we were to apply the teleological concepts, we might say that all 'indicia' of Vitalism do not prove 'dynamic' teleology, i.e. Vitalism, but only prove teleology in general, leaving the specification open, or 'static' i.e. machine-like or preformed, teleology (Driesch 1914a, p. 215).

Eventually, on a second level, Driesch goes on to find out which kind of teleology best explains the phenomena of life: "Descriptive teleology leaves the most important point still open, i.e. this question for life in particular: are the processes of life to be judged teleological only in virtue of their given order, only because a given mechanical form lies beneath them, while every single one is really a pure physical or chemical process, or are the processes of life purposive because of an unanalyzable autonomy?" (Driesch 1914a, p.5). According to Driesch, this is the

defining issue to solve: “The main question of Vitalism is not whether the processes of life can properly be called purposive: it is rather the question if the purposiveness in those processes is the result of a special constellation of factors known already to the sciences of the inorganic, or if it is the result of an autonomy peculiar to the processes themselves.” (Driesch 1914a, Introduction).

In order to answer the “main question of Vitalism”, Driesch focused on the analysis of the morphogenesis of the organism. Here we find one case of apparently purposive processes in living beings. According to Driesch, the main feature of the ontogeny of organisms is the production of visible manifoldness. That is, in the succeeding steps of morphogenesis, we move from simpler to more complicated forms of combination of parts (Driesch 1908 Vol. 1, p. 25). The question is therefore “whether there was already a ‘manifoldness’ in an invisible state, before development, or whether the phrase ‘production of manifoldness’ is to be understood in an absolute sense” (Driesch 1908 Vol. 1, p. 26). That is, when we look at the first steps of development, we want to know whether there is some kind of “machine” at the start of morphogenesis or not.

The first hypothesis corresponds to Driesch’s “machine-theory of life”. Here Driesch initially argued for a static teleological conception of this purposiveness. He claimed that while the overall machine shows some purposiveness in its actions, each single process is purposive only due to its position in the whole. According to this perspective, in the germ we find what Driesch calls extensive manifoldness, that is, “the single elements (…) are beside each other in space, or one after another in time, or both, always in a typical order” (Driesch 1908 Vol. 2, p. 137). This means that, at the start of development there is a spatial component (or machine, in a general sense) of some level of complexity: “all sorts of engines or machines are also extensive manifoldnesses in this meaning of the word.” (Driesch 1908 Vol. 2, p. 137).

However, as we saw, Driesch did not hold to the machine-theory of life for a long time. Driesch’s three proofs of the autonomy of life showed that, even though some processes of a functioning organism can be studied through physico-chemical laws, a machine cannot be the basis of ontogeny, and this means that an extensive manifoldness (spatial complexity of any kind) cannot be the origin of development. Driesch argued that all statical teleology has its origin in some elemental factor of life which acts teleologically. He called this factor Entelechy.

This is where we left off at the end of chapter 3. Let us now delve deeper into this question.

7.B – The Nature of Entelechy

7.B.1 – Inorganic Resolution

As we saw in the first part of "*Science and Philosophy of the Organism*" Driesch argues for the existence of Entelechy only by excluding other possible explanations: "There is something in organism's behaviour in the widest sense of the word which is opposed to an inorganic resolution of the same and which shows that the living organism is more than a sum or an aggregate of its parts, that it is insufficient to call the organism 'a typically combined body' without further explanation. This something we call Entelechy" (Driesch 1908 Vol. 2, p. 338). What is this "inorganic resolution"? And why is it insufficient?

As we just mentioned, on the one hand, in the mechanistic view the natural processes are explained by physico-chemical laws. On the other hand, in Driesch's machine-theory of life, the wholeness and organization of an organism is taken into account, that is, purposiveness is included. However, the structure of the organism is provided by a pre-existing "machine" in the germ. This means that, ultimately, it also relies on physico-chemical laws: "On the basis of these given properties, of this 'machine', we understand, with the aid of physics and chemistry, its functioning causally very well, the working of the developmental not less than that of the physiological 'machine'". (Driesch 1896, p. 364; quoted in Sander 1997, p. 37). For both theories (mechanism and the machine-theory), the common explanation is that the phenomena of life can be explained in terms of the laws of the inorganic world, whether there is a previous mechanical order or not. According to Driesch, these laws are manifestations of two categories: substance and causality.

The first category is the one of causality, "i.e. the principle of connexion of changes in spatial nature" (Driesch, 1908 Vol. 2, p. 156). According to Driesch, the category of causality is detected through the two principles of energetics in nature: "It seems to me that these principles, generally spoken of as the 'conservation of energy' and the 'augmentation of entropy' have their logical sources in the different aspects which causality offers to a thorough analysis. The 'cause' of an effect in spatial nature is that change in spatial nature which is invariably and 'necessarily' followed by the effect." (Driesch, 1908 Vol. 2, p. 158). Driesch claims that *energy*

is nothing but the measurement of causality: "'Energy' is a measurement and nothing else; it measures the amount of causality given off or received by a limited system in no other sense than the kilogramme or the pound measures the amount of gravitating matter." (Driesch, 1908 Vol. 2, p. 162).

The second category of nature is substance. Driesch affirms that the concept of substance is hard to define, yet, in a general sense it concerns what is extended in space: "Inorganic substance in any possible form relates to extensities, and that if it relates to varieties and manifoldness it does so with regard to extensive ones and nothing else" (Driesch, 1908 Vol. 2, p. 242). In fact, it can have a double sense: "Inorganic substance either is *extensity* itself, that is, space as the bearer of phenomenological reality, or it is a something consisting of absolutely single elements which are one beside the other *in extensity"* (Driesch, 1908 Vol. 2, p. 241). Here, in the place of the principle of conservation of energy, we have the principle of conservation of substance. These two principles are closely related: "(…) what is measured by "Ergs" [energy] is only the amount of causality as far as the latter has quantity and is therefore measurable, whilst substance relates to what is not touched by causality at all." (Driesch, 1908 Vol. 2, p. 240). However, there are differences between them since they "relate to two absolutely different branches of ontology. Energy 'is' not, but is realised in change; substance *is"* (Driesch, 1908 Vol. 2, p. 240).

These two categories are the basis of the inorganic world: "The category of substance thus became the foundation of all theories of matter; the category of causality became the foundation of dynamics in *any* of its forms, whether classical or electro-dynamical." (Driesch, 1908 Vol. 2, p. 307). And: "Now all inorganic nature, as the total system of all the constituents at work in it, is in space; and all potentialities, such as potentials, potential energies, constants, have their proper spatial locality. 'Causality' then means that one spatial change is univocally followed by another." (Driesch, 1908 Vol. 2, p. 319). The elements of the inorganic world are explained by the combination of these two categories: "causality implies substance because it cannot be thought of without a bearer that endures in spite of all change" (Driesch, 1908 Vol. 2, p. 306).

In summary: "All the elemental constituents that science operates with are modelled and formed according to the categorical system, each of them corresponding to a special ontological category of relation. Specificities with regard to quantity, quality, space, and time serve to give the definite character to each constituent, and the general notions of actuality and possibility complete the picture. Thus the constituents of nature, which are known as 'mass', 'force',

'potential energy of distance', 'constant' etc., are created. All these instances are such as occur in the sciences of the Inorganic; only the two categories of substance and of causality are at work here, as far as ontological relation is concerned." (Driesch, 1908 Vol. 2, p. 318). He adds: "Inorganic events can thus claim to be 'understood' by means of the categories of substance and causality, the word 'understand' being used here in a sense higher than the merely psychological." (Driesch, 1908 Vol. 2, p. 308).

As mentioned before, this view is common to mechanism and the machine-theory of life. In the latter, purposiveness is provided by the special constellation of factors. The issue is whether these properties can ultimately be explained by the categories of causality and substance, as the mechanistic view defends, subsumed into the perspective of physics: "In fact, mechanical physics in its *ultimate* aim tries to prove all combinations of properties in one thing on the one hand, and the totality of possible properties (and events) as such, on the other, to be the mere outcome of the possible kinds of equilibrium or causality of elemental matter." (Driesch, 1908 Vol. 2, p. 211).

7.B.2 – What Entelechy Is Not

However, as we have seen, Driesch discards the mechanistic view, and eventually discards his own machine-theory of life. According to him, the laws of inorganic matter are not sufficient to explain the purposiveness of living beings. In other words, Entelechy is not a manifestation of the categories of substance and causality. Driesch says that it cannot be reduced to inorganic compounds: there is no "inorganic resolution".

We can therefore start our analysis of Entelechy in this way: not by what Entelechy *is* but by what it *is not*.

Firstly, it is not a type of substance. As Smith puts it: "Is the entelechy that causes these actions of the organism dependent itself on its material body, as being the result either of some special kind of living matter or of a particular configuration of chemicals that we call a living body?" (Smith 1955, p. 203). Driesch argues that Entelechy is not a physical substance. He states this in two ways, claiming that "(…) entelechy is not identical with or a consequence of any chemical compound, or the constellation of such compounds (…)" (Driesch 1908 Vol. 2, p. 256). On the one hand, if Entelechy were some kind of substance, it would be a "living substance", bearing the Entelechy. Yet, according to Driesch "the living-substance theory has

been already refuted." (Driesch 1908 Vol. 2, p. 254). On the other hand, Entelechy is also not the outcome of a constellation of chemical compounds. We have already seen how Driesch refutes this suggestion (see section 3.B.3.1). This hypothesis also rests on the existence of a "living substance" because "newly arising elemental agents must be conceived as already pre-existing in some way." (Driesch 1908 Vol. 2, p. 254). Consequently, "(…) something purely chemical is found in the results only, but not in the processes. Without Entelechy there would be other chemical results." (Driesch 1908 Vol. 2, p. 254).

Ultimately, Driesch affirms that Entelechy is non-spatial – it is not present in a specific place: "An agent which is of a non-spatial nature cannot be said to have a definite seat or a definite localisation in space. Entelechy therefore cannot possess a 'seat'. It cannot at all be imagined like a point consisting of a something and moving through space, now in this and now in that direction (Driesch, 1908 Vol. 2, p. 258-259).

Alternatively, can Entelechy be a manifestation of causality?

As we saw above, Driesch affirms that causality in nature is measured by energy: "(…) we may say that energy measures the amount of causality which is spatial in itself" (Driesch, 1908 Vol. 2, p. 234). But, as the quote shows, the detection of energy indicates that there is some quantity to be measured: "All 'energies' actually known to exist or invented to complete the general energetic scheme, are quantities, and relate to phenomena which have quantity among their characteristics. In asserting these phenomena to be of the energetic order, we state that there can be a *more* or *less* of them, and that this more or less possesses most distinctly the faculty of being measurable (…)" (Driesch 1908 Vol. 2, p. 168-169). Yet, Entelechy does not have the characteristics of a quantity: "Entelechy is *order* of relation and absolutely *nothing* else; all the quantities concerned in its manifestation in every case being due to means which are used by Entelechy, or to conditions which cannot be avoided" (Driesch 1908 Vol. 2, p. 169). In the same way, it is not any other kind of manifestation of causality. It does not correspond to a factor that connects changes in spatial nature, that we know of: "We know already that it is not energy and not intensity, since quantity is not one of its characteristics. For the same reason it cannot be a 'force'; in any of the very ambiguous meanings of that word." (Driesch 1908 Vol. 2, p. 204).

Entelechy therefore belongs to neither of the categories of substance and causality: "Entelechy does not depend for its existence – I do not say for its active effects – on substance in space.

And for the same reasons for which it does not depend on substance in space we are allowed to say that it is not a species of so-called energy" (Driesch 1914b, p. 35). "(…) if it were material it would be subject to energetical changes, for it would be energetical itself; but that we have seen is an impossibility." (Driesch 1908 Vol. 2, p. 251). Entelechy is something unique: "Entelechies are *not* energies, *not* forces, *not* intensities, and *not* constants, but – entelechies." (Driesch 1908 Vol. 2, p. 205).

Up until this point we have sketched what Entelechy is not. But we have not yet presented positive claims: "In fact, the characteristics of entelechy form only a complicated system of negations so far, and little more." (Driesch 1908 Vol. 2, p. 259). What more can be said about its nature?

7.B.3 – A New Category

So far Driesch has affirmed that the laws of physics and chemistry are not enough to explain some processes of organisms: "We have shown that there are classes of phenomena in living nature which do not allow of any resolving into elements known from the study of the inorganic world. But we have shown nothing more. (Driesch 1908 Vol. 2, p. 160-161). That is, Entelechy is not a manifestation of the "inorganic categories".

Yet, Driesch is pointing to a deeper issue: Entelechy "(…) is neither a kind of energy nor dependent on any chemical material – more than that, it is neither causality nor substance in the true sense of these words." (Driesch 1908 Vol. 2, p. 338). This indicates that some new category of the natural world new has to be considered: "The important question now inevitably arises: (…) What is the meaning of saying that inorganic factors are not sufficient for explanation? In what way are inorganic factors, so to speak, counteracted in the organic world?" (Driesch 1908 Vol. 2, p. 160-161). That is: "(…) the phenomena of life are not explainable by the concepts and laws we know from inorganic science, but something new and elemental must be introduced by the science of biology." (Driesch, 1908 Vol. 2, p. 264).

Ultimately, in the terms that we just introduced, Driesch is saying that there has to be a new category beyond substance and causality: "And in our so-called indirect proofs of vitalism we discovered certain types of constellations of natural phenomena which needed the application of a new category of relation, besides substance and causality, if they were to be understood at all." (Driesch 1908 Vol. 2, p. 310).

What is Driesch pointing at? As we saw, both machines and organisms can be viewed as a constellation of single elements. Yet, while in machines we have a *sum* of these elements, in the case of organisms, we a have *unit* or *totality.* "There are indeed indefinite singular potencies at work in all of our systems during ontogeny: but the sum of what happens to arise in every case out of the sum of the single acts performed by all of the single equipotential cells is not merely a sum but a unit; that is to say, there exists a sort of harmony in every case among the real products of our systems. The term harmonious-equipotential system therefore seems to be the right one to denote them." (Driesch 1908, vol 1, p. 121). Driesch calls this new category "individuality" (that is, individual wholeness or unity)[161]: "The construction itself may be spatial or temporal or both; that is to say, the whole of the construction may be a typical order of elements in space or in time or in both; no matter, its logical aspect remains construction of individual wholeness in spite of its being composed of parts." (Driesch 1908 vol 2, p. 312). As we will see below, individuality corresponds to Driesch's concept of teleology.

Entelechy is the manifestation of the category of individuality, like mass and force are manifestations of substance and causality in the inorganic world. Entelechy is as essential as any of the physico-chemical laws: "And Life is 'understood' by the concept of Entelechy just as well as is inorganic nature by the concepts of energy, force, mass, etc. There is no need for further 'explanation'" (Driesch 1908 Vol. 2 p. 320).

The new category of individuality is required to have a full understanding of the world: "It would not be impossible to imagine a world in which only the category of substance were applicable – change would be wanting in such a world. And it would not be impossible to imagine a world deprived of entelechy but endowed with causality – there would be no organisms in such a world; the only realm of the category of individuality would be my mind" (Driesch 1908 Vol. 2 p. 368).

Driesch takes care to claim that individuality is not a special form of any other category, especially not causality: "Teleology is by no means 'causality seen from behind' as many of our dogmatic philosophers maintain. Teleology or individuality is as elemental as causality"

[161] The term individuality is commonly used for either simple or complex entities, but Driesch uses this term to refer to the unique and non-repeatable nature of the complex.

(Driesch 1908 Vol. 2 p. 335). But at the same time, individuality does not discard the other categories, but interacts with them: "But it is not imaginable that individuality is actively at work as dynamical teleology or entelechy has been at work, if it finds nothing to work with. It wants 'means' and matter including spatial causality is its means in the manner we have described. Thus, in fact, as we have said, individuality by no means destroys but implies causality; it would be an impossibility without it; it interferes or has interfered with causality here and there, but *not everywhere*." (Driesch 1908 Vol. 2, p. 367-368)

In summary, Entelechy is the manifestation of the unity or totality in organisms, which separates them from machines: "(…) the actual organism, as it offers itself to observation, is certainly a combination of singularities, each of which may be described in terms of physics and chemistry, like a machine, and also all changes in these singularities lead to results which may be so described, but the reason for the *origin* of the combination and of all its changes is not a law or any combination of laws taught us by physics and chemistry, but rests upon Entelechy (…)" (Driesch 1908 Vol. 2, p. 137). This category, individuality, describes the specific organization of living beings: "In fact, by saying that 'individuality' leads to individual construction and is elemental in itself the role of this category seems better expressed than in any other way. Some special category we *must* have in order to acquire any systematised experience about specific and typical constructions at all; there would not be *any* such experience without it." (Driesch 1908 Vol. 2 p. 312).

Ultimately, the phenomena of life are not reducible to any type of combination of the inorganic factors. They are explained through a new category. And this new factor, Entelechy, expresses the properties of life: "It is not only a short expression for a more complicated state of affairs, it expresses *a true element of nature*. Life, at least morphogenesis, is not a specialised arrangement of inorganic events; biology, therefore, is not applied physics and chemistry: life is something apart, and biology is an independent science." (Driesch 1908 Vol. 1, p. 142).

7.B.4 – Intensive Manifoldness

We have just seen that Entelechy is the manifestation of a new category: "[Entelechy] was found to be irreducible, autonomous, and not an aggregate of extensities. These were all negations, and could only be negations in the realm of the categories of substance and causality, as the necessary relations between changes in spatial nature. (…) Entelechy now becomes a

positive concept, created as the manifestation of the new category that was wanted. We now 'understand' entelechy. The ultimate results of our indirect proofs of vitalism – though they are by no means superseded by the 'new category' – acquire their proper intelligible meaning only at the moment when the foundation of entelechy upon a special category of its own is appreciated" (Driesch 1908 vol 2, p. 311). What other characteristics of Entelechy may we know?

As we saw at the start of this chapter, with the machine-theory of life, Driesch claims that at the beginning of morphogenesis there is already a spatial element of some complexity in the germ, that is, some kind of *extensive manifoldness*[162]. However, Driesch shows that there cannot be a spatial element at the origin of morphogenesis. Instead there is Entelechy. We have just seen that Entelechy is not a quantity or substance. In fact, according to Driesch it is not spatial at all. This means that Entelechy does not possess an extensive manifoldness characteristic of material components. Yet, there has to be some complexity in Entelechy. Smith affirms: "All the effects of entelechy are always complex 'manifolds' that are extended either in space – the organism itself – or in time – the actions of the organism. The entelechy itself, therefore, must in some fashion contain this organization; it must be a 'manifold' itself. The kind of manifoldness the entelechy possesses must differ from the extensive manifoldness characteristic of the material substance." (Smith 1955, p. 207).

The complexity of Entelechy is characterized by what Driesch calls *intensive manifoldness*, that is, "the elements of the manifoldness are neither one beside the other in space nor one after the other in time." (Driesch 1908 Vol. 2, p. 138). Entelechy "is an intensive manifoldness, i.e. it is an agent acting manifoldly without being in itself manifold in space or extensity. Entelechy therefore is only an agent that arranges, but not an agent that possesses quantity." (Driesch 1908 Vol. 2, p. 250).

What does Driesch mean by this? He claims that, while Entelechy is not spatial, it is an *active factor*. It does not 'exist' in space, but it acts into space. In other words, Entelechy is a natural agent: "We always must bear in mind that in dealing with Entelechy we are not dealing with anything psychical, or absolute, or metaphysical: we are analysing an agent at work in nature.

[162] By *degree of manifoldness* Driesch means "the number of different irreducible (elementary) characters which enter into its complete definition" (Driesch 1914a, p. 190). These characters are the object itself and its relations.

We know concerning this factor that it cannot be spatial in any sense, that it has no seat in space nor any dimensions, but merely acts 'into' space; in one word, that it 'is' not in spatial nature but only acts with regard to spatial nature." (Driesch, 1908 Vol. 2, p. 259). In von Uexküll's words: "While multiple, [Entelechy] does not exist in space; however, it operates on the things in space"[163] (von Uexküll 1913a, p. 46).

Since it is not in space we cannot detect it as it is, but only as it acts: "Now, as to entelechy, there is no intuition, and therefore space and all sorts of relations about space have practically nothing to do with entelechy. Entelechy itself is *conceived* only; it is *perceived* only in its extensive results." (Driesch 1908 Vol. 2, p. 257). We find it in the processes of living beings: "For Entelechy when at work in the organism leading its morphogenesis or governing its motor organs is also not 'in' the material organism but only manifests itself in this material" (Driesch, 1908 Vol. 2, p. 336).

Now this leads to the question: "But how is vitalism in its relations to inorganic phenomena intelligible at all, if Entelechy is neither dependent on spatial substance, nor energy itself, nor creative energy?" (Driesch 1914b, pg 36). That is, if Entelechy is not present in matter but acts on it, what exactly is this action? How can we detect it?

7.B.5 – Individualizing Causality

The action of Entelechy is intrinsically connected to what Driesch calls *becoming.* To briefly explain this, he elucidates how, in a general sense, we can consciously be aware of a "now". According to him, this "now" does not have any temporal component: "I have this immediate object, this content, now – that is all" (Driesch 1914a, p. 191). However a temporal element can appear in the form of signs: "and these signs, which are had in a now, mean 'not now but then (i.e. earlier)', and they may even mean 'earlier than'" (Driesch 1914a, p. 191). Causality is thus introduced. Consequently, not only do we have the "now" (or enduring) but we also have *becoming*: "What if becoming could be formulated as, if an earlier phase of it were always the reason of a later phase, and a later phase the consequence of an earlier one?" (Driesch 1914a, p. 192). The combination of becoming and being is what we find in the natural world: "In nature

[163] Sie ist, obgleich mannigfaltig, nicht im Raum vorhanden, mirst aber auf die Dinge im Raum

we may successfully search for something that endures, and in nature we may regard becoming as if any phase of it were the 'reason' of a later phase and the 'consequence' of an earlier one." (Driesch 1914a, p. 192)

Additionally, during becoming, "the degree of manifoldness in a natural system can never increase in itself" (Driesch 1914a, p. 197). This means that "the reason, then, is always of a higher degree of manifoldness than the consequence" (Driesch 1914a, p. 190). This means that Driesch denies any kind of self-organization by a natural system.

When we look at the types of becoming, in the inorganic world we only therefore find what Driesch calls single or additive causality: "The manifoldness of the system is here a mere sum: its different parts are changed in themselves, irrespective of the others. This is the type of becoming that is illustrated by the sciences of the inorganic world." (Driesch 1914a, p. 199). This means that "whenever there is an increase of the degree of manifoldness in the one spatial becoming that is to be rationalised, there must be a quasi-reason, i.e. a cause, for this increase that is outside the [natural] system itself" (Driesch 1914a, p. 198). As we mentioned above, it is here that we find Entelechy "which shows that the living organism is more than a sum or an aggregate of its parts, that it is insufficient to call the organism 'a typically combined body' without further explanation" (Driesch 1908 Vol. 2, p. 338).

So, what is the activity of Entelechy? We can already exclude some hypotheses. Given that in the natural world the principles of conservation of energy and matter apply, we cannot have creation of either of them. Smith sums it up: "We have seen that matter-creating causality and energy-creating causality, while a priori possible in the world, are not actually realized even in the organic realm, that is to say, that the principles of the conservation of energy and of matter hold true in living as in inorganic things." (Smith 1955, p. 201)

What type of "becoming" is produced by Entelechy? In brief it is "the augmentation of the degree of diversity of distribution among given elements; this action may also be formulated with regard to mechanics." (Driesch 1908 Vol 2, p. 336). Entelechy acts through what Driesch calls the unifying or individualizing causality: "in which a distribution of the things in one system of the form of a mere sum is transformed into a distribution that would be in some sense a unity or totality, without any spatial mechanical predetermination of this totality" (Driesch 1914a, p. 200). In this type of becoming, it is not the composition, but the distribution of the elements that changes into a new state. "Entelechy, though not capable of enlarging the amount

of the diversity of composition of a given system, is capable of augmenting its diversity of distribution in a regulatory manner, and it does so by transforming a system of equally distributed potentialities into a system of actualities which are unequally distributed." (Driesch 1908 Vol 2, p. 192). In other words, "the number of different kinds of relations among the things increases without there being any kind of spatial agency that can be made responsible for this increase" (Driesch 1914a, p. 200). In the inorganic world, the degree of manifoldness is therefore always the same or lower than in the previous state. But, with the introduction of Entelechy, the degree of manifoldness increases.

Here we see how individuality refers to the existence of an "individual wholeness", a unity or totality, as more than just the sum of different parts. And we see how Entelechy relates to the production of this unity, by increasing the complexity of the natural system. In summary, it is here that we detect the activity of Entelechy. As Smith puts it: "The only way we can know entelechy is by means of the effects produced by it on the body. This causality, 'individual causality', consists of creating in a material system a complexity of relationship not belonging to this system of itself." (Smith 1955, p. 207).

In summary: "Whenever there appears an harmonious-equipotential system in the course of its morphogenetic behaviour, the organism may even be said to be a quasi-verbal illustration of what unifying causality, as one of the types of possible non-mechanical forms of causality, means: a sum (of possibilities of happening) is transformed into a unity (of real results of happening) without any spatial or material preformation of this unity." (Driesch 1914a, p. 215). Driesch illustrates this phenomenon with the following diagram.

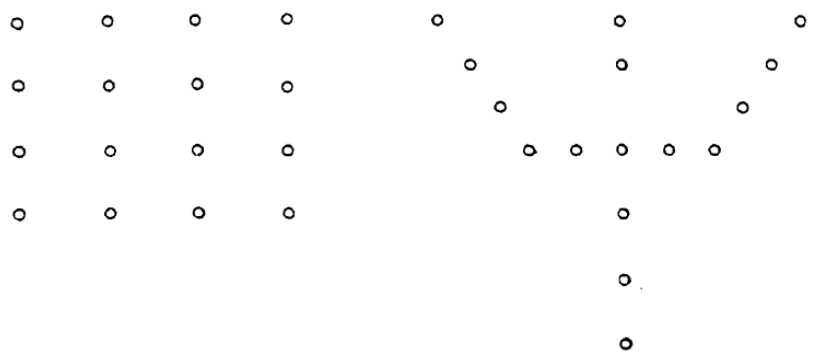

FIG. 2.—Diagram illustrating the fourth possible type of becoming.

A homogeneous distribution of elements is made heterogeneous without any machine-like preformation in space.

(Adapted from Driesch 1914b, p. 52)

7.B.6 – Suspending Change

Regardless of the detection of the effects of Entelechy, there is one question that we cannot ignore: how do we reconcile the activity of Entelechy with physico-chemical laws? Smith calls our attention to this point: "A primary difficulty seems to arise from the fact that the body of a living thing seems to submit to two different kinds of law; it is at once governed by the physical law that binds inorganic nature and by another group of laws unique to the biological kingdom. The first step in clarifying the relations of body and Entelechy must be to ask to what extent the Entelechy voids the physical law and how this is accomplished" (Smith 1955, p. 200).

We saw that, according to Driesch, the activity of Entelechy does not go against the laws of thermodynamics. It corresponds to an *individualizing* causality, which only affects the distribution of the already existing elements. As Smith puts it: "Driesch suggests, therefore, that the entelechy must interfere with the normal course of the natural laws only by guiding and arranging them for its own purpose." (Smith 1955, p. 201).

How does this happen? Importantly, this interference does not mean that Entelechy is able to remove any obstacle to the reactions. More specifically, according to Driesch, Entelechy works by both "suspending possible change and relaxing suspension" (Driesch 1914a, p. 202). It is able to "suspend for as long a period as it wants any one of all the reactions which are possible with such compounds as are present, and which would happen without Entelechy. And Entelechy may regulate this suspending of reactions now in one direction and now in the other,

suspending and permitting possible becoming whenever required for its purposes" (Driesch 1908 Vol 2, p. 180).

It is crucial to clarify this role of Entelechy. Entelechy does not produce new elements, nor does it create new reactions: "Entelechy only allows that to become real which it has itself held in a state of mere possibility—not what has been in this state simply as a result of physico-chemical influences." (Driesch 1914a, p. 205). In other words: "(…) the part played by Entelechy does not imply creation but implies regulatory admission of pre-established possibilities only" (Driesch 1908 Vol 2, p. 336). Entelechy is therefore not a creative agent, but a regulator. Allen emphasizes this as follows: "Entelechy was thus not the blueprint of an organism's organization, nor the creative agent that brings it about, but a kind of a mediator (…) (Allen 2008, p. 68).

Or, as Smith puts it: "Entelechy, as the suspension theory explains, does not create the difference that enables one substance to act upon the other, hence there will be no reactions between physical or chemical agents not already potentially reactive by nature. Nor can the entelechy create a substance it needs from elements that would not naturally cause such a result. All it can do is to interrupt and cause to resume a series of events that can take place according to nature's laws." (Smith 1955, p. 202).

In summary, when combined with the specificity of Individualizing causality, we can better appreciate the action of Entelechy: "Wherever there is life in the universe something happens that is not present in the given mechanical constellations as such: something is introduced, not changing the quantitative side but changing the *actuality* and *direction* of mechanical events." (Driesch 1908 Vol 2, p. 224).

7.C – Summary

So far, we have described Driesch's efforts to solve what he called the "fundamental problem of biology", which we introduced in section 3.B. That is, the nature of teleology in living beings: "Are those processes in the organism, which we described as purposive, perhaps only purposive in virtue of a given structure or tectonic, of a 'machine' in the widest sense (…); or is there another special kind of teleology in the realm of organic life?" (Driesch 1914a, p. 4). We could also ask, in other words: is teleology static or dynamic?

As we described in Part 1, Driesch's static teleology, in the form of the machine-theory, suggests that the purposiveness of natural processes can be exclusively determined by their position in the whole individual, as the outcome of another primarily given physico-chemical combination of a fixed character, as in machines. (Driesch 1908 Vol. 2, p. 341).

But eventually Driesch finds evidence in favour of the second hypothesis. In the terms introduced above, the unity or totality of an organism is not just the combination of its elements; it is instead defined as "dynamical teleology": "There was a natural factor at work, autonomic and not resulting from a combination of other agents, but elemental in itself; this factor acted teleologically: it therefore may be called a factor of dynamical teleology" (Driesch 1908 Vol.2, p. 136). There is an extra-material agent behind the super-mechanical properties of life – Entelechy: "Because it possesses this faculty *without* being of the nature of an energy at the same time, entelechy is *the* non-physico-chemical agent." (Driesch 1908 Vol 2, p. 180). Accordingly: "As being an intensive manifoldness Entelechy belongs to the general sphere of dynamic teleology: there is something teleological *in* its very work" (Driesch 1908 Vol. 2, p. 138).

Ultimately, there are still processes in both morphogenesis and physiology of the organism that can be explained in a physico-chemical way. But Driesch shows that, in the end, the events of morphogenesis are not provided by a special constellation of the physico-chemical parts, but by a factor irreducible to them: "In other words, there are many processes in an organism which are of the statical-teleological type, which go on ideologically or purposefully on a fixed machinelike basis; but Entelechy has created this basis, and so statical teleology has its source in dynamical teleology." (Driesch 1908 Vol. 2, p. 151).

We can now recapitulate what we have discovered about Entelechy: "Entelechy, as we know, is a factor in nature which acts teleologically. It is an intensive manifoldness, and on account of its inherent diversities it is able to augment the amount of diversity in the inorganic world as far as distribution is concerned. It acts by regulatively suspending and setting up free reactions based upon potential differences. There is nothing like it in inorganic nature." (Driesch, 1908 Vol. 2, p. 205).

Hein effectively summarizes these characteristics: "[Driesch] does not identify [Entelechy] as primary cause and pattern of self-realization, but rather as a regulator governing which of the various potentialities resident in the material system is to be permitted realization and which is to be restrained. Entelechy is thus not the template of organic organization, nor

the creative agent which brings it about; but it serves as a kind of insurance which protects the built-in tendencies of the organic system from being disrupted by adverse environmental conditions. Having neither substantive being nor creative energy, it is held to offer no violation of the physical laws of nature. It is nonspatial, nontemporal, and nonpsychic, in all respects nonquantifiable; but it is upon specific portions of matter that it has effect. It neither increases nor decreases the features of the material world but only alters their organization". (Hein 1972, p. 170)

Chapter 8 – Von Uexküll: Conformity with Plan

At the end of the previous section, we reached what Driesch understands to be Vitalism: "Dynamic teleology leads us to what is generally called Vitalism; it leads us to the recognition of the 'Autonomy of vital processes'" (Driesch 1914a, p. 6). Von Uexküll affirms that this is the strictly vitalist position. These are the supporters of a special vital force present in organisms. This force not only directs the processes of development but also the functioning of the organs which are all reduced to some kind of autonomy in their natural life (von Uexküll 1913b, p. 27).

Now we approach the above-mentioned key question: how does von Uexküll's biological theory compare with Driesch's? Where can we place his biological findings on the discussion on the properties of life? In order to develop this analysis, we can outline the contrast between the two authors using von Uexküll's terms, as Brentari describes: "Teleology can mean on the one hand purposiveness, goal-directedness or tension towards an end (*Zweckmässigkeit*), on the other compliance or conformity to a plan (*Planmässigkeit*). The Aristotelian and Drieschian teleology is of the first type, while the Uexküllian one belongs to the second." (Brentari 2015, p. 237).

How should we therefore describe von Uexküll's *Planmässigkeit*? What does von Uexküll mean when he says that it is "nothing more than that the parts are ordered in correspondence with a design or plan, in such a way that they form a whole with a functional unity"[164] (von Uexküll 1913a, p. 194). Is *Planmässigkeit* a concept best described as something like "static teleology", or is there a dynamic factor as well? In von Uexküll's words, there should not be one, at least not one like Driesch's Entelechy: "One can agree with Driesch on the details; to me the main question always appears to be if, in general, we should introduce or not an immaterial factor in the natural sciences. The safest path is to avoid it as much as

[164] (…) weil mit Planmäßigkeit im strengen Sinne weiter nichts gesagt ist, als daß die Teile entsprechend einem Grundrisse oder einem Plane derart angeordnet sind, daß sie gemeinsam ein einheitlich funktionierendes Ganzes bilden.

possible"[165] (von Uexküll 1913a, p. 46-47). Let us take a deeper look into von Uexkull's teleological ideas.

8.A – No Purposiveness

What does von Uexküll say about the purposefulness of biological events? In chapter 4 we already mentioned that von Uexküll defends an intermediate position: neither vitalism nor mechanicism. He accepts the mechanist approach but interprets it in a teleological sense: the processes of living beings (N.B. of the corresponding Totalities or Worlds) are guided by their conformity to the *Bauplan.*

According to von Uexküll, *Zweckmässigkeit* denotes the end as the representation of a future situation that becomes the motive of an action. He thus terms the tension directed towards this representation "conformity with an end" (von Uexküll 1913b, p. 176). But, in order to understand von Uexküll's position, the key point is the distinction between *Zweckmässigkeit* and *Zielstrebigkeit*. Von Uexküll eventually uses the term *Zielstrebigkeit* to denote a general purposefulness of the organism, while avoiding a vitalistic connotation. Instead of "purpose" (*Zweck*) this new term refers to "goal" (*Ziel*). This distinction was first made by von Baer: "Karl Ernst von Baer, who at the time discussed these problems very thoroughly, also came to the conclusion that he should flatly reject the 'conformity with an end' (*Zweckmässigkeit*) in nature. Instead of the purpose, he declared the 'goal' to be crucial in nature. We will be able to make Baer's idea clear through an example he chose: When a bullet flies out of the barrel and hits the target, the target is the factor that dictates the path of the bullet. If you remove the shooter, you have to attribute to the bullet itself the property of being directly influenced by the target in its direction of movement. The bullet then, as Baer puts it, has "goal-directedness" (*Zielstrebigkeit*)"[166] (von Uexküll 1928, p. 217-218). In the case of organisms, this effort is targeted towards their adult form: "Karl Ernst von Baer, the father of the evolutionary doctrine, saw in the building plan (*Bauplan*) of the adult the end towards which the evolution tended

[165] Man mag sich im einzelnen mit Driesch einverstanden erklären, die Hauptfrage scheint mir immer die zu sein, ob man überhaupt einen immateriellen Faktor in die Naturwissenschaft einführen soll oder nicht.

[166] Karl Ernst von Baer, der seinerzeit diese Probleme sehr gründlich erörtert hat, ist gleichfalls zum Schluß gelangt, die Zweckmäßigkeit in der Natur rundweg abzulehnen. Er hat statt des Zweckes das „Ziel" für ausschlaggebend in der Natur erklärt. Wir werden uns den Gedanken Baers durch ein von ihm gewähltes Beispiel deutlich machen können: Wenn eine Kugel aus dem Lauf fliegt und das Ziel trifft, so ist das Ziel derjenige Faktor, der der Kugel die Bahn vorschreibt. Denkt man sich den Schützen fort, so muß man der Kugel selbst die Eigenschaft zuschreiben, sich vom Ziel direkt in ihrer Bewegungsrichtung beeinflussen zu lassen. Die Kugel besitzt dann, wie Baer sich ausdrückt, „Zielstrebigkeit".

(*zustrebt*) *ab ovo*, and talked of goal-directedness (*Zielstrebigkeit*) as a strength that resides inside each living being"[167] (von Uexküll 1913a, p. 157).

Von Uexküll rejects the idea of *Zweckmässigkeit* through his observation of fittingness (*Einpassung*) between the organism and its *Umwelt*. This idea was introduced in Chapter 5: "It seems to be that the word in question is fittingness, for it denotes nothing but the undisputed fact that organism and environment (*Umgebung*) fit one another"[168] (von Uexküll 1928, p. 217). Von Uexküll uses this term in opposition to the Darwinian term "adaptation" (*Anpassung*). According to von Uexküll, the term "adaptation" indicates that there has been a progression in the way in which each subject and the *Umwelt* fit one another: "This introduced two principles into the word that did not come from observing nature. First, it means that A and B do not match from the start, and second, that it takes time for them to fit one another"[169] (von Uexküll 1928, p. 216). But, as we have discussed in the previous sections, from the point of view of his biological theory this is not acceptable. Von Uexküll's functional circle means that the subject and the *Umwelt* are always in perfect harmony. There is no room for chance events. Von Uexküll's *Einpassung* therefore highlights this permanent fittingness between the two elements: "So far as the means at the disposal of an animal extend, fittingness (*Einpassung*) is always perfect. If all organisms fit in perfectly with their surrounding world (*Umwelt*), there is no such thing as gradual attainment of perfection; the perfection of fittingness is there everywhere from the very beginning"[170] (von Uexküll 1928, p. 217).

We are thus faced with a strange corollary: how is it possible that we have an organism perfectly fitted in with its *Umwelt* from its first moments as the first germ cell? This happens despite there not being a way for the environment and germ cell to fit with each other at this stage: "We have to come to terms with this fact: on the one hand, the properties of the outside world (*Außenwelt*), which have no guiding influence, and on the other, there is the living germ, which has no organs that could impart to it knowledge of these properties. And yet we see how

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[167] Karl Ernst v. Baer, der Vater der Entwicklungsgeschichte, sah im *Bauplan* des erwachsenen Tieres das Ziel, dem die Entwicklung vom Keim an zustrebte, und sprach von einer Zielstrebigkeit als von einer Kraft, die jedem Lebewesen innewohnt.

[168] Ein solches Wort scheint mir die „Einpassung" zu sein, da es nichts anderes besagt, als die unbestrittene Tatsache, daß Lebewesen und Umgebung ineinander passen.

[169] Damit waren zweierlei Prinzipien mit in das Wort hineingebracht worden, die nicht aus der Beobachtung der Natur stammten. Erstens ist damit ausgesagt, daß A und B von vornherein nicht zueinander passen, und zweitens, daß das Passendwerden eine gewisse Zeit erfordert.

[170] Die Einpassung ist immer vollkommen, soweit die dem Tier zur Verfügung stehenden Mittel reichen. Wenn alle Lebewesen vollkommen in ihre Umwelt eingepaßt sind, so gibt es keine allmähliche Vervollkommnung, sondern die Vollkommenheit der Einpassung ist überall von vornherein vorhanden.

the germ with perfect precision produces certain counter-properties that fit into a group of certain properties of the outside world (*Außenwelt*)"[171] (von Uexküll 1928, p. 219).

According to von Uexküll, this happens because the organism is not directed by a certain purpose or goal, but by the conformity with a pre-determined plan, which includes both the subject and the *Umwelt*. But how does von Uexküll support the hypothesis that there is a plan directing the actions of living beings? The supporting theoretical considerations have an experimental basis. He attempts to illustrate the difference between goal and plan through a series of experiments.

In one experiment he looks at the process of attraction of female crickets towards males. He observes how the female crickets are guided towards a male by the sound of his rubbing wings. However, he observes that the females are only directed by the sound of a male, and that when the sound indication is absent, they do not follow other kinds of indications: "In one room, in front of a microphone that serves as a reception device, there sits a lively fiddling individual. In another room, members of the opposite sex gather before a speaker, paying no attention to another individual who fiddles in vain because he is sitting under a bell jar, which his music does not penetrate. The mates cannot come together, since the optical image has no effect whatsoever."[172] (von Uexküll 1956, p. 61). Similarly, as observed in another experiment, a mother hen can identify its chick when there is a sound indication but not a visual one, while the reverse is not true: having only a visual indication does not guide the hen towards its chick (von Uexküll 1956, p. 64-65).

These experiments show how animals respond to a specific indication, irrespective of its source. According to von Uexküll, they are not therefore following a goal, a defined purpose (like reaching for the female cricket, or the stranded chick). They are only responding to a specific indication. And this correspondence is pre-determined in their plan. As Weiss puts it, in the sense that nature's apparent failures: "(…) will be understood if we realize that the

[171] Mit dieser Tatsache haben wir uns abzufinden: auf der einen Seite die Eigenschaften der Außenwelt, die keinen richtunggebenden Einfluß ausüben, und auf der anderen der lebendige Keim, der keine Organe besitzt, die ihm die Kenntnis dieser Eigenschaften vermitteln könnten. Und doch sehen wir, wie der Keim mit vollkommener Sicherheit bestimmte Gegeneigenschaften hervorbringt, die in eine Gruppe bestimmter Eigenschaften der Außenwelt eingepaßt sind.

[172] In einem Zimmer sitzt vor dem Mikrophon als Empfangsapparat ein lebhaft geigendes Exemplar. In einem Nebenzimmer sammeln sich vor einem zweiten Telephon die Geschlechtspartner und kümmern sich nicht im geringsten um ein unter der Glasglocke sitzendes Exemplar, das vergebens geigt, weil die Töne nicht hervordringen können. Eine jede Annäherung der Partner bleibt so aus. Das optische Bild ist ohne jede Wirkung.

animal's actions and motions follow a *plan* but do not pursue an aim. They will, in case of a disturbance not provided for, continue to be performed in accordance with the plan, which, since the aim is not realized, cannot, by deliberation, be modified so as to suit the new situation which the disturbance has brought about." (Weiss 1948, p. 56). Or as von Uexküll himself puts it: "Both experiments prove the same point: it is hardly a case of pursuing a goal."[173] (von Uexküll 1956, p. 62)

This means that, firstly, the notion of conformity with an end (*Zweckmässigkeit*) as the explanation for finality is rejected: "Instead of seeing in it merely a rule stretching across time and space, men have spoken of 'purpose' and 'purposefulness' in Nature; and this introduced the idea of Nature as a sort of human being, foreseeing future events and acting accordingly. But just where conformity with plan is easiest to detect, we can find no trace of any such human-like being. It is advisable therefore to dismiss from biology, for all time, expressions such as 'purpose' and 'purposefulness'" (von Uexküll 1926, p. 270). According to von Uexküll, there is not a future goal to which an organism aims. In other words: "Uexküll rejects both the Aristotelian and Drieschian versions of this theory (where the task of making the future act on the present is left to Entelechy, a sort of spaceless and timeless archetype of the species), (Brentari 2015, p. 237)". Consequently, he avoids using the term *Zweck* when referring to nature: "The reason is that Zweck and Ziel, like the English aim, purpose, end in view, mostly bear to the modern reader a meaning which makes them unsuited for the interpretation of nature as seen by Uexküll" (Weiss 1948, p. 55).

All things considered, von Uexküll's focus shifts from the purposive understanding of nature towards a conformity with a pre-determined plan: "It should therefore be our first concern to extinguish the will-o'-the-wisp of the goal in our observation of environments. This can only happen inasmuch as we consider the vital expressions of animals from the vantage point of the plan."[174] (von Uexküll 1956, p. 60).

At this point some crucial clarifications should be made to allow us to narrow down von Uexküll's position.

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[173] Beide Versuche zeigen das gleiche. Von der Verfolgung eines Zieles ist in keinem Fall die Rede.
[174] Es muß daher unsere erste Sorge sein, das Irrlicht des Zieles bei der Betrachtung der Umwelten auszulöschen. Das kann nur dadurch geschehen, daß wir die Lebensäußerungen der Tiere unter dem Gesichtspunkte des Planes ordnen.

On the one hand, we should bear in mind that the rejection of a vital element in nature does not mean that its action is left to the ruling of physico-chemical laws: "(…) every organism is a formation in which the individual parts are united according to a permanent plan, and this formation does not constitute a randomly fermenting pile of materials obeying only physical and chemical laws"[175] (von Uexküll 1913a, p. 19).

On the other hand, when von Uexküll argues that the processes and actions of living beings are guided by a plan he does not mean that the plan is visualized and targeted by the organisms in question: "the teleological processuality of the animal and plant world is completely devoid of any kind of representation that could, so to speak, 'anticipate' the end on the cognitive level." (Brentari 2015, p. 237). In other words, an animal does not consciously follow this plan: "(…) consciousness is altogether excluded from animal life. And the perception, or Uexküll's *Merken*, of which the animal is indeed capable, does not include the phenomenon in question. The animal perceives various data, but it does not perceive the *plan*. Besides, in the life, for example, of an embryo, where there definitely is a *plan*, there is as yet no perception at all. We should therefore not think of a *plan* as of a purpose" (Weiss 1948, p. 55). In summary: "[the animal] does (…) in no way perceive the *plan*, though it moves according to that *plan*." (Weiss 1948, p. 55).

In this way, von Uexküll steps away from both the mechanistic view and Driesch's teleological ideas: "As long as it has all its mechanical and chemical properties, every living being fits with perfect conformity with plan (*Planmässigkeit*) into its surrounding world (*Umwelt*). This is the deadly blow to the doctrine that denies conformity with plan (*Planmässigkeit*) in nature. At the same time – and this is less obvious – the doctrine of conformity with an end (*Zweckmässigkeit*) in nature falls. A purpose (*Zweck*) i.e. an idea that has been transferred to the future does not guarantee the full use of all available means, but this will always be achieved more or less completely"[176] (von Uexküll 1928, p. 217).

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[175] (…) daß jeder Organismus ein Gebilde ist, in dem sich die einzelnen Teile nach einem festen Plane zusammenfinden und das nicht einen planlos gärenden Stoffhaufen darstellt, der nur physikalischen und chemischen Gesetzen gehorcht.

[176] Ein jedes Lebewesen ist, solange es seine sämtlichen mechanischen und chemischen Eigenschaften besitzt, in seine Umwelt mit vollkommener Planmäßigkeit eingefügt. Damit ist zunächst die Lehre, die die Planmäßigkeit in der Natur leugnet, erledigt. Zugleich — und das ist weniger augenscheinlich — fällt die Lehre von der Zweckmäßigkeit in der Natur. Ein Zweck, d. h. eine in die Zukunft verlegte Vorstellung trägt keineswegs die Gewähr für die vollkommene Ausnützung aller vorhandenen Mittel in sich, sondern diese wird stets mehr oder weniger vollkommen erreicht werden.

As we anticipated in Chapter 4, von Uexküll's conformity with a plan (*Planmässigkeit*) can therefore be described as an intermediate position, neither mechanistic nor purposive: "(…) we find three ontologically distinct regions: matter with its mechanical laws, living nature moving according to *plans* of nature, human life possessed of thought." (Weiss 1948, p. 56). In summary we could say, with Weiss: "Nature is unmechanical, yet, in a way, blind, but with a blindness different from that of mechanical causation. In nature there are *plans* but no aiming. There is no conscious insight into the whole of the situation." (Weiss 1948, p. 57).

8.A.1 – *Planmässigkeit*

Once again, we reach the central idea behind von Uexküll's biological theory: all events in living beings happen in conformity to a plan. Yet, this concept may seem absurd. How can we have a natural plan directing the processes of living beings? As in the previous example, how is it possible to conceive of a bullet that directs itself to its target? This concept seems absurd to us because to purposiveness (*Zweckmässigkeit*) we associate a psychological entity, able to cognize its end. But this is not the case with *Zielstrebigkeit.* It seems strange, but it is what is at stake. As Weiss puts it: "Can we declare a concept absurd, while something in reality corresponds to it? The fact that the conception of a plan without a noticeable planner has hitherto been given no place in our thought can hardly be proof that it is valueless. In the realm of being, if not yet in the realm of thought, the phenomenon of a plan without an observable planner does appear to exist. Should we not, then, have to produce a concept which faithfully represents this reality?" (Weiss 1948, p. 58)

As mentioned above, von Uexküll criticized the view that the world could be understood only through physico-chemical laws, or laws of mechanical causality. However, von Uexküll does not deny the existence of these laws. Everything exists according to these laws. However, besides these laws of causality, there is another set of laws that he calls "subjective laws". This subjectivity is not reducible to causal laws; it is something new, which includes them: "(…) biology has to deal only with the conformity with plan (*Planmässigkeit*) and (…) the study of causality can only be considered in so far as it contributes to the study of the conformity with

plan (*Planmässigkeit*)"[177] (Von Uexküll 1928, p. 102). In our last section on von Uexküll (on the *Umwelt*) we saw how these laws appear. The development and the regulation of organisms is directed by the *Bauplan*. But this guidance is not restricted to the body of an organism and extends towards its surrounding world (*Umwelt*). The *Umwelt* of each subject is unique to it and is closed off to other subjects. The whole world of an organism is therefore under the rule of this subjective law, which is the conformity with plan (*Planmässigkeit*).[178] Overall, it is decisive to remember that the distinctive feature of von Uexküll's view is the fact that *Planmässigkeit* is not part of an objective world, but it represents the medium inside which everything that we are describing exists. "Even where Nature is active in super-mechanical ways, there is no arbitrariness anywhere, but always a law. A law, however, which is also a design of the most exalted kind, and which casts its spell over the entire process" (von Uexküll 1926, p. 290). *Planmässigkeit* is not an object, but it encompasses everything, even our own perspective. Here we can refer to Epimenides, as quoted by St. Paul: "For in him we live, and move, and exist"[179] (Acts 17, 28).

We can thus understand von Uexküll when he points out the importance of biology: "If by biology we understand the doctrine of conformity with plan in the world of living things, we shall realise that one of the fundamental inquiries of the science [sic] must be into the nature of this conformity" (von Uexküll 1926, p. 270). Sciences such as physics and chemistry only take into account the laws of causality, and do not account for the conformity with plan. For biology, which studies the phenomenon of life, the understanding of organisms as being in conformity with plan is indispensable. "For chemistry and physics do not know conformity with plan (*das Planmässige*) as a natural factor. Biology, however, consists in setting up a framework of principles that recognizes conformity with plan (*das Planmässige*) as the very basis of life."[180] (Von Uexküll 1928, Foreword – p. VI). This conformity is the decisive property of life: "Organisms are by their very nature shaped by conformity with plan (*planmässig*). If you take

[177] (...) daß die Biologie sich nur um die Planmäßigkeit zu kümmern hat und die Erforschung der Kausalität nur insofern in Frage kommt, als sie zur Erforschung der Planmäßigkeit mit beiträgt.
[178] While Driesch understands purposiveness as part of an organism, of life, von Uexküll understands *Planmässigkeit* as a property of an animal and its surrounding world. This means *Planmässigkeit* is a fundamental property of the world, which, as we have discussed in chapter 5, is characterized by being not one absolute world, but several subjective ones, each one a totality in itself.
[179] In ipso enim vivimus, et movemur, et sumus
[180] Denn Chemie und Physik kennen das Planmäßige als Naturfaktor nicht. Die Biologie besteht aber in der Aufstellung eines Gerüstes von Lehrsätzen, die das Planmäßige als Grundlage des Lebens anerkennen.

away the building plan (*Bauplan*) and functional plan (*Funktionsplan*), they break down into their inorganic components and are no longer alive"[181] (Von Uexküll 1928, p. 229).

In von Uexküll's view, under *Planmässigkeit* the biological processes of organisms are guided by the *Bauplan*: "Uexküll thinks he is solving the problem by acknowledging a third and intermediary ontological region. The causation found in nature is *sui generis*. A plan is at work, as Uexküll puts it (…) (Weiss 1948, p. 57). In chapter 7 we analysed Driesch's Entelechy and saw how this factor acts on the world of nature, producing unity and totality. It is an active agent that intervenes in biological processes. This purposeful organization is at the basis of life. Alternatively, we have seen how von Uexküll distances himself from Entelechy and any purposeful agent. We are thus faced with this question: If there is no dynamic factor, like Entelechy, how does the *Bauplan* guide the processes of organisms?

We therefore reach the key issue: how to understand von Uexküll's apparent vitalism. The main question is: what is the role of the *Bauplan* in the organization of living beings? As we saw in Chapter 4, the discovery of the super-mechanical properties in organisms suggested that the *Bauplan* could be something more than just the spatial and functional organization of an organism, that is, a true factor of nature. This step turns out to be especially interesting if we recall that we have already introduced an intermediate factor between the *Bauplan* and the protoplasm of organisms: impulses. This means that we have some evidence that the *Bauplan* can indirectly affect protoplasmic material. How does this interaction compare to the action of Entelechy?

8.A.2 – The Role of the *Bauplan*

We initially saw how the key to understanding both machines and organisms is the connection of all parts into a whole. "When the carpenter's axe chops up wood into rods and sticks, and when the drill bores through rods and the hammer drives sticks into holes, what we are dealing with here are causal sequences. But the structure emerging from this process, the ladder, cannot be interpreted by causality at all; it can be understood only from the knowledge of the designed

[181] Organismen sind ihrem Wesen nach planmäßig. Nimmt man ihnen Bau- und Funktionsplan, so zerfallen sie in ihre anorganischen Bestandteile und sind nicht mehr lebendig.

arrangement of the rungs with relation to the main rods, and of all the parts to the whole"[182] (von Uexküll 1928, p. 84).

This means that for both machines and organisms there has to be a construction plan according to which the parts are organized. We found this to be what von Uexküll terms the *Bauplan*. "Everywhere, the characteristic features of this nature factor (*Naturfaktor)*, the Plan, are clearly revealed. Here, too, each plan forms an indivisible whole. If suitable material is available, any plan can be repeated at will. Each plan is broadly independent of volume, and each plan is blind to its neighbours"[183] (von Uexküll 1929, p. 40).

However, as pointed out above, the *Bauplan* stands not only for the spatial but also for the functional plan of organisms and machines. "We also researched the conformity with plan (*Planmässigkeit*) and found that it is always based on a function"[184] (von Uexküll 1928, p. 99). "The fixed rule of climbing activity immediately brought order to the tangle of sticks and holes and formed the ladder. It is only after knowing the associated activity rule of "function" that the parts become a whole. Without knowledge of the function that establishes fixed relationships, we lack knowledge of the conformity with plan (*Planmässigkeit*), and then we do not recognize the meaning of the object."[185] (von Uexküll 1928, p. 86). "The operational plan (*Betriebsplan*) of a rotating windmill, for example, is quite identical to the building plan (*Bauplan*) of a stationary mill."[186] (von Uexküll 1929, p. 39)

When we refer to *Planmässigkeit*, both its spatial organization and the functional role should therefore be considered: "because conformity with plan means nothing more than that the parts are ordered in correspondence with a design or plan, in such a way that they form a

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[182] Wenn die Axt des Schreiners das Holz in Stangen und Stöcke spaltet, der Bohrer die Stangen durchbohrt und der Hammer die Stöcke in den Löchern sind, so sind das lauter reine Kausalreihen – das hierbei erhaltenene Gebilde, der Leiter, ist aber kausal gar nicht zu begreifen , nur nur durch Kenntnis der planvollen Beschaffung der Sprossen zu den Stangen und aller Teile zum Ganzen.

[183] Überall treten die charakteristischen Eigenschaften des Naturfaktors Plan deutlich zutage. Jeder Plan bildet auch hier ein unteilbares Ganzes. Jeder Plan kann sich, wenn geeignetes Material vorhanden ist, beliebig wiederholen. Jeder Plan ist in weiten Grenzen unabhängig vom Volumen und jeder Plan ist blind gegenüber seinen Nachbarplanen.

[184] Wir haben ferner die Planmäßigkeit erforscht und gefunden, daß ihr immer eine Funktion zugrunde liegt.

[185] Die feste Regel der Tätigkeit des Kletterns brachte sofort Ordnung in das Gewirr von Stöcken und Löchern und formte die Leiter. Erst die Kenntnis der zugehörigen Tätigkeitsregel der „Funktion" ordnet die Teile zum Ganzen. Ohne Kenntnis der Funktion, welche feste Beziehungen setzt, fehlt uns die Kenntnis der Planmäßigkeit, dann erkennen wir die Bedeutung des Gegenstandes nicht.

[186] Der Betriebsplan einer sich drehenden Windmühle z. B. ist durchaus identisch mit dem *Bauplan* einer stillstehenden Mühle.

whole with a functional unity"[187] (von Uexküll 1913a, p. 194). In other words: "We can therefore speak of an object's "functionality" [or conformity with function] (*Funktionsmässigkeit*) instead of the object's "plannedness" [or conformity with plan] (*Planmässigkeit*)"[188] (von Uexküll 1928, p. 86)

What else do we find when we compare machines and organisms?

As machines are produced and organisms complete their development, both are in conformity with their plan. The fundamental difference is that, ultimately, machines are built by an external agent, namely their creator. This means that while both organisms and machines are in conformity to a plan, in organisms we detect a set of properties that cannot be found in machines: the super-mechanical properties. This shows that, unlike machines, organisms are autonomous entities: "Every cell has its own in-built law (*Eigengesetzlichkeit*); it is therefore an autonomous entity (*Autonom*), because its own in-built law (*Eigengesetzlichkeit*) is part of the nature of an autonomous entity. And therein lies the difference compared to all machines; these too have a rule that turns their activity into a function. However, this rule is never a subjective one; it is rather instilled into the machine from the outside. And this is why machines are never autonomous."[189] (von Uexküll 1928, p. 168).

In order to be built and fixed, machines are under the influence of an external functional "steersman" (*Betriebsleiter*): "A machine, once it has been built by a human being is nothing but matter and only obeys causality. It is therefore dead and needs a functional steersman (*Betriebsleiter*) to maintain its conformity with plan (*Planmässigkeit*)"[190] (von Uexküll 1928, p. 200). What about living beings? Since they are autonomous entities, there is no builder or creator as in the case of machines: "But the action of genesis in the organism (to which regeneration of destroyed tissues is to be reckoned) is direct, whereas that of machines is,

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[187] (...) weil mit Planmäßigkeit im strengen Sinne weiter nichts gesagt ist, als daß die Teile entsprechend einem Grundrisse oder einem Plane derart angeordnet sind, daß sie gemeinsam ein einheitlich funktionierendes Ganzes bilden

[188] Wir können daher auch statt von der Planmäßigkeit eines Gegenstandes von seiner „Funktionsmäßigkeit" sprechen.

[189] In allen Zellen sind die Tätigkeiten durch eine Regel zu einer gemeinsamen Funktion verbunden. Diese Regel verwandelt die Zelle in ein selbständiges Zentrum, das eine selbständige Existenz führt. Jede Zelle besitzt ihre Eigengesetzlichkeit, sie ist daher ein Autonom, denn die Eigengesetzlichkeit gehört zum Wesen des Autonomes. Darin liegt der Unterschied zu allen Maschinen; auch diese besitzen eine Regel, die ihre Tätigkeit in eine Funktion verwandelt. Diese Regel ist aber niemals eine subjektive, sondern ist von außen her der Maschine eingeflößt. Daher sind die Maschinen niemals autonom.

[190] Eine Maschine ist, wenn sie einmal vom Lebewesen Mensch erbaut wurde, restlos Stoff und gehorcht nur noch der Kausalität. Sie ist daher tot und bedarf zur Aufrechterhaltung ihrer Planmäßigkeit eines lebenden Betriebsleiters.

without exception and in its very nature, indirect, since it proceeds from the actions of its constructors, which are conditioned by indications [notes]" (von Uexküll 1926, p. 326). We should also be able to find some kind of "regulator" in the organisms.

The key to this issue lies in the nature of the plan itself. We saw that on a first level, both organisms and machines have equivalent sets of rules of genesis and function: "(…) the rule that we form with the aid of our apperception when we consider the working of some particular framework (be it a living being or a machine)" (von Uexküll 1926, p. 235). However, now the question begs itself. In machines, the existence of the rules was not enough to explain their development and maintenance. Why should it therefore be so in organisms? How is the regulation different in organisms? "In spite of all these very fine details in the control mechanism of animals, the body machine, like any other machine, even if its operating rules (*Betriebsregel*) have been carefully worked out, will never be able to continue working without an operational management (*Betriebsleitung*) in the long run."[191] (von Uexküll 1928, p. 206)

The answer has already been glimpsed in Chapter 5: A machine is built by humans, meaning that its functional rule is the one provided by the builder. Its *Bauplan* is an extension of the *Bauplan* of its builder. In machines we find what von Uexküll terms an *alien* and *passive* plan (*fremder und passiver Plan*) and also passive operating rules (*passive Betriebsregel*): "machines are dependent on an alien and passive plan"[192] (von Uexküll 1928, p. 214). "the passive operating rule, which controls the mechanical sequence of the processes in the control mechanism"[193] (von Uexküll 1928, p. 208). By passive plan von Uexküll means a plan that describes the working of machines, but which does not have an active role in their functioning. It means "an alien plan (*Fremdplan*) that once unites the machine parts with one another, but which can neither maintain operation nor repair damage."[194] (von Uexküll 1928, p. 200). The construction and maintenance of a machine is always produced by the builder: "an alien and passive building plan, which makes it completely dependent on the carpenter"[195] (von Uexküll 1928, p. 214). A functioning machine thus has no ability to alter its functions: "Only these

[191] Trotz all dieser sehr fein ausgebildeten Einzelheiten im Steuermechanismus der Tiere ist die Körpermaschine ebenso wie jede andere Maschine, auch wenn ihre Betriebsregel auf das sorgfältigste durchgearbeitet ist, niemals imstande, ohne eine Betriebsleitung auf die Dauer weiter zu arbeiten.
[192](...) die Maschinen von einem fremden und passiven Plan abhängig sind
[193] (...) die passive Betriebsregel, die den mechanischen Ablauf der Prozesse im Steuermechanismus beherrscht
[194] (...) kein Fremdplan, der die Maschinenteile einmalig ineinanderfügt, der aber weder den Betrieb aufrecht zu erhalten, noch Schäden auszubessern vermag.
[195] (...) eines fremden und passiven *Bauplan*es, der ihn völlig vom Tischler abhängig macht

[machines] are incapable of change because machines consist exclusively of a fixed framework (*Gefüge*) and all the rules that can be derived from their spatial structure (*Bau*) and their functions are human rules that do not belong to them but are carried into them from the outside. These rules can therefore only be changed from outside through human intervention."[196] (von Uexküll 1928, p. 146)

We have now taken a decisive step in uncovering the nature of the *Bauplan*. The plans and rules of machines are only descriptive, in the sense that they do not have an active role in their functions. This is all provided by their builder. If animals are different from machines, if animals are true living beings, then they must possess a different kind of *Plan*, and consequently different types of rules. These must be active and not just descriptive factors. Von Uexküll claims that, in contrast with machines, living beings have an active and in-built plan of their own (*aktiver Plan* and *Eigenplan*) and consequently their own rules. "(…) animals have an their own in-built (*eigenen*) and active plan (*aktiver Plan*)"[197] (von Uexküll 1928, p. 214). "(…) this plan affects them autonomously, which is not the case with machines. It therefore becomes a built-in plan (*Eigenplan*) and does not remain an alien plan (*Fremdplan*) that once unites the machine parts with one another, but which can neither maintain operation nor repair damage."[198] (von Uexküll 1928, p. 200).

Machines are always tied to the autonomy of their builder while organisms are not: "Regardless of whether they are perception tools (*Merkmittel*) or effector tools (*Wirkmittel*), mechanisms always form products (*Erzeugnisse*) of the subject, whose plans remain for them alien plans that have been passively imprinted on them. On the contrary, the plans that dominate the works in the body of a living subject are in-built plans *(Eigenpläne),* and as such they are active. This applies not only to the works of the body, but also to the elements from which all works are built – the cells."[199] (von Uexküll 1929, p. 38). That is, the plans of machines are

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[196] Nur sind diese keiner Wandlung fähig, weil die Maschinen ausschließlich aus einem festen Gefüge bestehen und alle Regeln, die man aus ihrem räumlichen Bau und ihren Funktionen ableiten kann, menschliche Regeln sind, die nicht ihnen angehören, sondern von außen in sie hineingetragen sind. Daher können diese Regeln auch nur von außen her durch Eingriffe des Menschen abgeändert werden.

[197] die Tiere einen eigenen und aktiven Plan besitzen,

[198] Aber dieser Plan wirkt sich in ihnen autonom aus, was bei den Maschinen nicht der Fall ist. Er wird also zum Eigenplan und bleibt kein Fremdplan, der die Maschinenteile einmalig ineinanderfügt, der aber weder den Betrieb aufrecht zu erhalten, noch Schäden auszubessern vermag.

[199] Mag es sich um Merkmittel oder Wirkmittel handeln, stets bilden die Mechanismen Erzeugnisse des Subjekts, dessen Pläne für sie *Fremdpläne* bleiben, die ihnen passiv aufgeprägt wurden. Dahingegen sind die Pläne, die die Werke im Körper des lebenden Subjekts beherrschen, *Eigenpläne,* und als solche sind sie aktiv. Dies gilt nicht nur für die Werke des Körpers, sondern auch für diejenigen Elemente, aus denen sich alle Werke aufbauen – die Zellen.

heteronomous, while those of living beings are autonomous. (von Uexküll 1928, p. 214). "In all cells, the activities are linked to a common function by a rule (*Regel*). This rule transforms the cell into an independent centre that leads an independent existence. Every cell has its own in-built law (*Eigengesetzlichkeit*); it is therefore an autonomous entity (*Autonom*), because its own in-built law (*Eigengesetzlichkeit*) is part of the nature of an autonomous entity. And therein lies the difference compared to all machines; these too have a rule that turns their activity into a function. However, this rule is never a subjective one, it is rather instilled into the machine from the outside. And this is why machines are never autonomous."[200] (von Uexküll 1928, p. 168). The super-mechanical properties should therefore be accounted for by the rules connected to the *Eigenplan* of an organism. There has to be a factor exclusive to organisms.

Von Uexküll claims that besides the rules present in both organisms and machines "there is also a natural factor that works after the manner of a rule; this is not operative in implements [type 2 objects] but only in organisms" (von Uexküll 1926, p. 235). However he adds: "This rule, however, cannot be ascribed to a hidden framework, because the hypothetical hidden framework must likewise divide and duplicate itself, a process that is just as insoluble mechanically."[201] (von Uexküll 1928, p. 204) And he concludes: "Here one must also decide and acknowledge that forces according to plan are at work. All forms according to plan that we know are always products of other forms in conformity with plan. These are not present here, and we witness the moving spectacle of how a plan of nature emerges as a form-maker."[202] (von Uexküll 1928, p. 204-205).

Von Uexküll calls this factor the "*Leiter*" (the steersman, the steering or controlling instance in an organism)[203] . "Uexküll's answer to the question whether 'the physical laws of

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[200] In allen Zellen sind die Tätigkeiten durch eine Regel zu einer gemeinsamen Funktion verbunden. Diese Regel verwandelt die Zelle in ein selbständiges Zentrum, das eine selbständige Existenz führt. Jede Zelle besitzt ihre Eigengesetzlichkeit, sie ist daher ein Autonom, denn die Eigengesetzlichkeit gehört zum Wesen des Autonomes. Darin liegt der Unterschied zu allen Maschinen; auch diese besitzen eine Regel, die ihre Tätigkeit in eine Funktion verwandelt. Diese Regel ist aber niemals eine subjektive, sondern ist von außen her der Maschine eingeflößt. Daher sind die Maschinen niemals autonom.

[201] Diese Regel läßt sich aber auf kein Geheimgefüge zurückführen, weil das hypothetische Geheimgefüge sich gleichfalls teilen und verdoppeln müßte. Ein Vorgang, der ebensowenig mechanisch lösbar wäre.

[202] Hier muß man auch entscheiden und anerkennen, daß planmäßige Kräfte am Werke sind. Alle planmäßigen Formen, die wir kennen, sind immer Erzeugnisse anderer planmäßiger Formen. Diese sind hier nicht vorhanden, und wir werden Zeugen des ergreifenden Schauspiels, wie ein Naturplan als Formbildner unverhüllt hervortritt.

[203] Instead of translating it as "regulator", the term used in the 1926 English version of von Uexküll's *Theoretical Biology*, we prefer to translate *Leiter* as "steersman" (the steering or controlling instance in an organism). To put it in Cicero's terms, the point is that a living organism is, as it were, both the vine and its own viticulture: both the plant and the gardener: "*Suppose the art of viticulture, whose function is to bring the vine with all its parts into the most thriving condition — at least let us assume it to be so (for we may invent an imaginary case, as you are fond of doing, for purposes of illustration); suppose then the art of viticulture were a faculty residing in the vine itself,*

metabolism' or the 'organization' of organisms could explain the 'origin' of a 'perpetual regeneration' in a self-regulative order is clear: there must be a ruler [steersman] that "coordinates" (*regelt*) the processes of formation and maintenance, and there must also be a ruler if these processes are in disorder. Without a ruler, processes could not be 'harmonized'; they would 'run out' (*sich tot laufen*) and end in disorder" (Cheung 2004, p. 150).

In conclusion: "The subject is distinguished from the implement [type 2 object] by possessing an autonomous function-regulator, and it also has an autonomous rule of genesis; this being likewise a natural factor, may be called genesis-regulator" (von Uexküll 1926, p. 235). The introduction of the steersman, the steering or controlling instance in the organism (*Leiter*) raises the stakes of our investigation. It means that we are closer to identifying the factor of life, the one that is exclusive to living beings, and eludes the analysis of machines: "If we start out from the already emphasized difference in the management of machines and living beings, according to which machines are dependent on an alien and passive plan, while animals have their own in-built and active plan, we can ask ourselves the question: what characteristics would a very simple utensil, such as a chair, reveal if, instead of an alien and passive building plan, which makes it completely dependent on the carpenter, it had its own in-built and active building plan, if it were not a heteronomous entity but an autonomous one?"[204] (von Uexküll 1928, p. 214).

8.B – Steersmen

As we just saw, in organisms the plans and rules are not just the conceptual terms that we use to describe their organization. They are also able to actively direct the natural processes of morphogenesis and regulation, and this is the reason why von Uexküll speaks of a *Leiter*: a steersmen – or manager – that is, a steering or controlling instance. Like the impulses, the *Leiter* works as an intermediate factor placed between the *Bauplan* and the cells of living beings.

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this faculty would doubtless desire every condition requisite for the health of the vine as before, but would rank itself above all the other parts of the vine, and would consider itself the noblest element in the vine's organism." (Cic. Fin. 4, 38)

[204] Gehen wir vom bereits hervorgehobenen Unterschied in der Betriebsleitung bei Maschinen und Lebewesen aus, wonach die Maschinen von einem fremden und passiven Plan abhängig sind, während die Tiere einen eigenen und aktiven Plan besitzen, so können wir uns die Frage vorlegen: welche Eigenschaften würde ein ganz einfacher Gebrauchsgegenstand, etwa ein Stuhl, offenbaren, wenn er statt eines fremden und passiven *Bauplan*es, der ihn völlig vom Tischler abhängig macht, einen eigenen und aktiven *Bauplan* besäße, wenn er nicht ein Heteronom, sondern ein Autonom wäre?

This leaves us with two main questions to answer in the following sections: First: how do the intermediary factors affect the processes in an organism? And second: how are they under the guidance of the *Bauplan*? We will start by looking into the first one.

As we have seen from the previous analysis on the natural processes of organisms, the organization of an organism into a whole is provided by the *Bauplan*. However, while the plan is fixed, its influence on the events of the life of an organism is expressed in the form of rules, such as the rule of genesis and the functional rule (von Uexküll 1909, p. 12-13). In short, on the one hand, we have the plan which gives the spatial representation of the process; on the other hand the rule which provides the representation of the temporal sequence of all processes, the functions of organisms. "In contrast to the construction plan (*Bauplan*), which indicates a spatial representation of the processes, the developmental rule (*Bildungsregel*) shows the chronological sequence of all processes (…)" (Pobojewska 1993, p. 62).

Moreover, von Uexküll mentions how we can find the rule inscribed in the framework (*Gefüge*) of the *Bauplan*. "In both [machines and organism] we find a fixed framework, which forms the externally visible expression of a rule. The framework is responsible for carrying out the action that follows the functional rule"[205] (von Uexküll 1928, p. 146). As Cheung puts it: "The *Gefüge* of the protoplasm and of the growing organism is thus at the same time a material *Gefüge* of visible structures and of 'immaterial' plans that 'induce' the *Gefügebildung* according to certain 'rules'" (Cheung 2004, p. 147). It is crucial to clarify that the rule does not carry any purposiveness or "effort towards a goal". As Buchanan points out "This may account for why Uexküll allows for a 'rule' to stretch across time and space, but not one that considers purposive ends. To see a purpose is to presume insight into the full working of nature and thus to also perhaps see where it is heading. If this were the case, we would not only have insight into nature as a whole, which presumes the absolute standpoint of physics that he has already dismissed, but also the ability to interfere and control nature's future. This would further suppose that nature's rules may be altered or changed. In contrast, the rules of nature's plan appear to be unalterable." (Buchanan 2008, p. 20).

[205] Wir finden bei beiden ein festes Gefüge, das den äußerlich sichtbaren Ausdruck einer Regel bildet. Das Gefüge übernimmt die Ausführung der Handlung, die der Funktionsregel folgt.

In order to answer the first question presented above, let us now see how the different moments of the development and working of organisms are regulated in conformity with plan.

The above analysis of von Uexküll's ideas showed us how the direction of the natural processes of organisms in conformity with plan can be seen in the two time phases of their life: "The life of such animals falls into two distinct parts. In the first, the organs are formed; in the second, they are used. In the first, the rule of genesis is in control; in the second, the rule of function" (von Uexküll 1926, p. 210). This means that in these two different phases two specific plans can be observed, as summarized by Cheung: "There are two different general plans in all organisms: one for 'formation processes' (*Gestaltungsvorgänge*) and one for 'regeneration processes' (*Regenerationsprozesse*) in the wider sense, that is to say processes that also include metabolism." (Cheung 2004, p. 150).

So far, we have seen how the simple schematic understanding of the plans and rules of both animals and machines is insufficient to explain specific events, such as their development and regulation. Now our task is to look into the two main moments in the life of a living being: development and functionality. Our driving question is: How do we perceive the role of the steersman – or manager – in each of the moments of the life of an organism? Here we hope to see the action of the *Bauplan*.

8.B.1 – Time of Becoming – The Organizer

The first moment when we can identify the working of steersmen – or managers – in the natural processes of living beings is their development. We see how an organism grows and is shaped by complex embryonic steps. According to the theory of factors put forward by von Uexküll, in the first moments of development there is not a material plan in a germ cell. The directing of the ontogeny is given by the plan outside of the framework, which is a framework forming agent (von Uexküll 1926, p. 195). As development progresses, the *Bauplan* is revealed in the form of the framework. "The young germ, therefore, does not carry the construction plan stamped on itself in any material form. The protoplasm is gradually acquiring a structure according to plan; it does not house it from the beginning."[206] (von Uexküll 1913a, p. 42). "As we were able to establish when living things came into being, with each new bud the indifferent

[206] Es trägt also der junge Keim den Bauplan in irgendeiner materiell ausgeprägten Form nicht in sich. Das Protoplasma gewinnt erst nach und nach eine planmäßige Struktur, es beherbergt sie nicht von Anfang an.

autonomous cellular entity (*Zellautonome*) takes up a foreign plan that was not previously present in it"[207] (von Uexküll 1928, p. 200).

How does the *Bauplan* inform the different steps of morphogenesis?

The most simple life form is the cell. This means that it is autonomous, and we can say that the cell has its own *Plan*. "Each cell consists of a protoplasmic foam formation with ongoing metabolic activity and a nucleus, which probably regulates the metabolism with the help of ferments. This rule or cell plan is an autonomous and at the same time active factor. And this is why I termed the living cell an *autonomous entity (Autonom).* Only in this way can we understand that the protoplasm lasts forever. If the protoplasm were nothing more than a mixture of substances in garb, it would sooner or later have to die. The fact that this does not happen is unmistakable proof that an own in-built plan (*Eigenplan*) actively intervenes here and regulates the metabolism in such a way that its operation is permanently maintained."[208] (von Uexküll 1929, p. 38). Consequently, each cell has also a rule, subordinated to that plan, as mentioned before: "In all cells, the activities are linked to a common function by a rule (*Regel*). This rule transforms the cell into an independent center that leads an independent existence. Every cell has its own law (*Eigengesetzlichkeit*), it is therefore an autonomous entity (*Autonom*), because its own law (*Eigengesetzlichkeit*) is part and parcel of the nature of its autonomy."[209] (von Uexküll 1928, p. 168).

While cells are autonomous, throughout development their division is coordinated. Groups of cells divide in a harmonised way in order to produce the different tissues of the embryo. Von Uexküll calls these groups of cells buds (*Sprosse*). "If we call all the cells of a group that perform their divisions according to a uniform plan a bud, we can see that each germ (*Keim*) initially represents a primary bud (*Primärsproß*), from which a number of secondary buds

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[207] Wie wir bei der Entstehung der Lebewesen feststellen konnten, nehmen die indifferenten Zellautonome bei jeder neueinsetzenden Sprossung einen fremden Plan auf, der vorher in ihnen nicht vorhanden war.
[208] Eine jede Zelle besteht aus einem im Stoffwechsel befindlichen protoplasmatischen Schaumgebilde und einem Kern, der wahrscheinlich mit Hilfe von Fermenten den Stoffwechsel regelt. Diese Regel oder dieser Zellplan ist ein autonomer und zugleich aktiver Faktor. Weshalb ich die lebende Zelle ein *Autonom* genannt habe. Nur unter dieser Voraussetzung ist die Tatsache zu verstehen, dass das Protoplasma ewig währt. Wäre das Protoplasma nichts Anderes als ein in Gärung begriffenes Stoffgemisch, so musste es sich über kurz oder lang tot laufen. Dass dieses nicht geschieht, ist ein untrüglicher Beweis dafür, dass hier ein Eigenplan aktiv eingreift, und den Stoffwechsel so regelt, dass sein Betrieb dauernd erhalten bleibt.
[209] Jede Zelle besitzt ihre Eigengesetzlichkeit, sie ist daher ein Autonom, denn die Eigengesetzlichkeit gehört zum Wesen des Autonomes.

(*Sekundärsprosse*) emerge."[210] (von Uexküll 1929, p. 41).

However, while each bud is also autonomous, they act in a coordinated manner as they grow and divide in the embryo: "(…) each individual cell does not create its own special impulse directing it to a predestined place, but all the cells within a germinal area are directed in common, behaving like iron-fillings under the influence of a magnet." (von Uexküll 1926, p. 213). This indicates that they must also be in conformity with a common plan. "First, a new in-built plan (*Eigenplan*) must actively intervene in the autonomous cellular entity, which controls its metabolism according to plan, which produces a division machine that surpasses the formation of tissues in finesse and precision. (…) The division processes of the individual cell subjects usually occur in groups in a larger number of cells simultaneously. Proof that the individual active division plans are part of a supra-subjective plan"[211] (von Uexküll 1929, p. 41).

How is the plan of the bud harmonised with the plans of the independent cells? It is here that we find the steersman – or manager – of morphogenesis: the organizer. "Each bud works according to its own in-built plan, and since this plan itself actively intervenes to regulate the cell division in such a way that the organ is shaped from the disordered cell group, we have the right to talk like Spemann about an *organizer (Organisator)"*[212] (von Uexküll 1929, p. 41). The organizer was discovered through experiments made in 1920 by Hans Spemann and his graduate student Hilde Mangold (Hamburger 1999, p. 232). Von Uexküll describes Spemann's experiment with Triton larvae: "Spemann cut a round cell island out of the upper lip of a gastrula in the process of formation and grafted it onto another seedling on the underside. The cells on the underside become epidermal cells in the normal course of things. The grafted-in cells, however, sprouted a medullary plate and forced the cells of their new neighbourhood to take part in this completely heterogeneous formation. Spemann therefore called the graft, which

[210] Wenn wir sämtliche Zellen einer Gruppe, die nach einem einheitlichen Plan ihre Teilungen vollziehen, einen *Sproß* nennen, so können wir feststellen, dass jeder Keim anfangs einen Primärsproß darstellt, aus dem eine Anzahl Sekundärsprosse hervorgehen.

[211] Erst muß im Zellautonom, das seinen Stoffwechsel planmäßig beherrscht, ein neuer Eigenplan aktiv eingreifen, der eine Teilungsmaschine hervorruft, welche an Feinheit und Präzision selbst die Gewebsbildung in den Schatten stellt. (...) Die Teilungsvorgänge der einzelnen Zellsubjekte treten meist gruppenweise in einer größeren Anzahl von Zellen gleichzeitig auf. Ein Beweis dafür, daß die einzelnen aktiven Teilungspläne einem übersubjektiven Plan eingegliedert sind.

[212] Jeder Spross arbeitet nach seinem eigenen Plan, und da dieses Planselbst aktiv eingreift, um die Zellteilung so zu regeln, dass die Organgestalt aus der ungeordneten Zellgruppe, haben wir das Recht, mit SPEMANN von einem *Organisator* reden.

automatically creates organs, an "organizer" (*Organisator*)."[213] (von Uexküll 1928, p. 170).

From this experiment, von Uexküll explains the role of the organizer: "A transplanted cell group experiences a completely different fate, depending on whether it was already under the rule of an organizer or not. In the first case, the cell group develops 'according to its origin' and forces the autonomous cellular entities surrounding it to follow its budding plan. In the other case, it develops 'according to the location' i.e. according to the foreign environment, because it itself comes under the rule of an alien bud plan (*eines fremden Sprossplanes*)."[214] (von Uexküll 1929, p. 41).

The organizer is therefore able to direct the budding plans of other parts of the embryo. "An organizer is therefore a plan that dominates cell divisions."[215] (von Uexküll 1929, p. 41). Or "the plan that dominates the budding (…)"[216] (von Uexküll 1928, p. 205). "(…)[Spemann] calls them 'organisers', because they have the power to impose their organisation upon the still undifferentiated cell-material surrounding them." (von Uexküll 1926, p. 213).

The effect of one plan on the other is called induction (*Induktion*). "This proved induction, that is, the ability of a cell graft that has become an organizer to cause a bud in a foreign cell layer without being involved in the budding itself. At the same time, it was likely that the graft had also received its organizational skills through induction."[217] (von Uexküll 1928, p. 170). This concept "is suitable for building the bridge between the budding plans"[218] (von Uexküll 1929, p. 43). "This is to say that there are complementary budding plans, one of

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[213] Spemann schnitt aus der Oberlippe einer in der Bildung begriffenen Gastrula eine runde Zellinsel heraus und pfropfte diese einem anderen Keimling auf der Unterseite ein. Die Zellen auf der Unterseite werden im normalen Verlauf der Dinge zu Epidermiszellen. Die eingepfropften Zellen aber ließen aus sich eine Medullarplatte hervorsprießen und zwangen die Zellen ihrer neuen Nachbarschaft, sich an dieser ihnen durchaus heterogenen Bildung zu beteiligen. Spemann nannte daher den selbsttätig Organe schaffenden Pfropf einen „Organisator".

[214] Dank der von ihm ausgearbeiteten Pfropfungsmethode war SPEMANN in der Lage festzustellen, dass bei *Triton*-Keimen eine verpflanzte Zellgruppe ein völlig anderes Schicksal erfährt, je nachdem ob sie bereits unter der Herrschaft eines Organisators stand oder nicht. Im ersten Falle entwickelt sich die Zellgruppe „herkunftsgemäß" und zwingt die sie umgebenden Zellautonome, sieh ihrem Sprossplan anzuschleifen. Im anderen Falle entwickelt sie sich „ortsgemäß" d.h. der fremden Umgebung entsprechend, weil sie selbst unter die Herrschaft eines fremden Sprossplanes gerät

[215] Ein Organisator ist daher ein die Zellteilungen beherrschender Plan.

[216] Das drückt sich im Wort Organisator aus, das Spemann für den die Sprossung beherrschenden Plan und in dem Wort Mechanisator aus, das ich für die aktive Funktionsregel gewählt habe, die gleichbedeutend ist mit funktionsfähigem Bauplan.

[217] Damit war die Induktion bewiesen, d. h. die Fähigkeit eines zu einem Organisator gewordenen Zellpfropfes in einem fremden Zellschicht eine Sprossung zu veranlassen, ohne an der Sprossung selbst beteiligt zu sein. Zugleich war es wahrscheinlich gemacht, daß der Pfropf seine organisatorischen Fähigkeiten ebenfalls durch Induktion erhalten hatte.

[218] (...) den Begriff der Induktion herausgearbeitet, der die Brücke zwischen den Sprossplänen zu schlagen geeignet ist.

which can evoke the other even in a distant cell layer."[219] (von Uexküll 1929, p. 43).

As we mentioned above, the conformity with plan is maintained by a steersman – or manager – who directs the natural processes. In morphogenesis, it is the organizer: "The organizer corresponds to the construction manager (*Bauleiter*) [that is, the "building-steersman"]"[220] (von Uexküll 1928, p. 205)

How does this induction and regulation by the organizer happen? Von Uexküll does not reveal the answer: "Bud formation and induction are not final solutions, but new problems, namely super mechanical problems. This is not surprising given that all cells are autonomous cellular entities, i.e. carriers of their own law, which is always an immaterial factor. The transfer of laws from autonomous entity to autonomous entity, because that is what we are dealing with here and not a mere transfer of substances or movements, is such a difficult problem that it seems provisionally unsolvable. But it is a great step forward that it has even become visible."[221] (von Uexküll 1928, p. 171)

In summary, we have the organizer which directs the cell divisions of the developing embryo. The action of the organizer is detected in the form of the developmental plan (*Erbauungsplan*) and the rule of genesis (*Entstehungsregel*). "Thus, in the final analysis, it is the developmental plan (*Erbauungsplan*), i.e. an immaterial factor, which dominates the autonomous cellular entities (*Zellautonome*) and prescribes their course of development (*Bildungsgang*) according to the position they occupy in the respective body system."[222] (von Uexküll 1928, p. 172).

8.B.2 – Critical Point

As development progresses, the framework of an organism is gradually produced. However, as mentioned in Chapter 4: "the framework restricts framework formation" (von Uexküll 1926, p.

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[219] Das soll besagen, dass es komplementäre Sprossplane gibt, von denen der eine den anderen selbst in einer entfernten Zellschicht hervorzurufen vermag.
[220] Bei Maschinen würde der Organisator dem Bauleiter (...) entsprechen.
[221] Sproßbildung und Induktion sind keine endgültigen Lösungen, sondern neue Probleme, und zwar übermechanische Probleme. Dies ist nicht weiter erstaunlich, wenn man sich vor Augen hält, daß alle Zellen Autonome sind, d. h. Träger ihres eigenen Gesetzes, das immer ein immaterieller Faktor ist. Die Übertragung von Gesetzen von Autonom zu Autonom, denn darum handelt es sich hier und nicht um eine bloße Übertragung von Stoffen oder Bewegungen, ist ein so schwieriges Problem, daß es vorläufig unlösbar scheint. Aber es ist schon als großer Fortschritt zu bezeichnen, daß es überhaupt sichtbar geworden ist.
[222] Somit ist es letzten Endes der Erbauungsplan, d. h. ein immaterieller Faktor, der die Zellautonome beherrscht und ihnen je nach der Stelle, die sie im jeweiligen Körpersystem einnehmen, ihren Bildungsgang vorschreibt.

216). And here we reach the *critical point*: "As an independent natural factor (*Naturfaktor*), the rule of genesis (*Entstehungsregel*) continues its prescribed course up to the critical point and no further."[223] (von Uexküll 1928, p. 174). At this point, the regulation of the natural processes shifts from the rules of genesis to the rules of function. "The moment the tissues and organs are finished – when, as we say, functionality begins, the technical management passes from the hand of the developmental plan (*Erbauungsplan*) to the hand of the building plan (*Bauplan*). I call this moment the critical point"[224] (von Uexküll 1922, p. 160).

The original germ cell did not possess any kind of spatial plan, only protoplasm, but now the organism also possesses a framework: "Now the effect of the critical point expresses itself in every cell of each germinal area, in such a way that the gene present in it becomes active and allows its specific framework to crystallize out of the protoplasm. At one stroke a fully developed earthworm, with all its functions, is got from the protoplasmic worm. And therewith the genetical building-stones have disappeared, which consisted of protoplasm alone: in their place functional building stones have come in, consisting of framework+protoplasm" (von Uexküll 1926, p. 295).

Up to here, the natural processes were kept in conformity with plan by the construction steersman – or manager – (*Bauleiter*) or organizer. At the critical point, the regulation is now provided by the operational steersman – or manager – (*Betriebsleiter*) (von Uexküll 1928, p. 205). "The finished machine is taken over by an operational steersman – or manager – (*Betriebsleiter*) who has to ensure that the spatial building plan, which is expressed in the relationships of the parts to one another and to the whole, is retained. (…) The spatial building plan, like the time-related developmental plan (*Erbauungsplan*), is an active factor." (von Uexküll 1922, p. 159). Von Uexküll calls this "steersman" the mechanizer (*Mechanisator*): "It shows that another factor is needed to maintain the developed cell mechanism, the "mechanizer"." (von Uexküll 1928, p. 125).

The analysis of this new time plan in organisms thus requires looking into this new factor: "We are therefore again forced to look for an immaterial factor that belongs to life alone.

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[223] Die Entstehungsregel geht als selbständiger Naturfaktor ihren vorgeschriebenen Gang bis zum kritischen Punkt und nicht weiter

[224] In dem Augenblick, da die Gewebe und Organe fertiggestellt sind – wenn, wie wir sagen, die Funktion beginnt, geht die technische Leitung aus der Hand des Erbauungsplanes in die Hand des *Bauplan*es fiber. Ich nenne diesen Augenblick den kritischen Punkt.

I propose to call this factor, whose function is to obtain the mechanism in the cell in form, the "mechanizer"".[225] (von Uexküll 1928, p. 123)

8.B.3 – Time of Being – The Mechanizer

After the processes of development, the framework of the *Bauplan* is now complete in the organism.

"Once the framework is in place, the activity can take place of necessity within the structure (*Rahmen*) of the framework."[226] (von Uexküll 1928, p. 99). As mentioned with regard to the machine and organism analogy, both, after their construction, work according to a plan. But as we already emphasized, their plans are different: "machines are dependent on an alien and passive plan, while animals have their own in-built and active plan"[227] (von Uexküll 1928, p. 214). Similarly, we can distinguish the passive from active rules: "Once again we see two rules at work to give the actions their character: the passive operating rule (*die passive Betriebsregel*), which controls the mechanical sequence of the processes in the control mechanism, and the active rule of the operational steersman (*die aktive Betriebsleitungsregel*), which, by shaping the operation, brings structure to the otherwise inevitable processes"[228] (von Uexküll 1928, p. 208).

In the case of machines, stating that the plans and rules are passive and alien means that the conformity with plan is maintained through the external action of the builder. Machines are not autonomous. Organisms, however, are. They are able to direct the events of regulation and regeneration. "I now maintain that the operational plan (*Betriebsplan*) that operates in the functional circle is an active plan that constantly manages the functions. In it we have to see the sought-after life factor (*den gesuchten Lebensfaktor*), which is to be held responsible for both

[225] Deshalb sind wir wiederum gezwungen, nach einem immateriellen Faktor zu suchen, der dem Leben allein angehört. Ich schlage vor, diesen Faktor, dessen Aufgabe darin besteht, den in der Zelle vorhandenen Mechanismus in Form zu erhalten, den „Mechanisator" zu nennen.
[226] Ist das Gefüge einmal vorhanden, so kann die Tätigkeit zwangmäßig im Rahmen des Gefüges ablaufen.
[227] (...) wonach die Maschinen von einem fremden und passiven Plan abhängig sind, während die Tiere einen eigenen und aktiven Plan besitzen (...)
[228] Wieder sehen wir zwei Regeln am Werk, um den Handlungen ihr Gepräge zu geben: die passive Betriebsregel, die den mechanischen Ablauf der Prozesse im Steuermechanismus beherrscht, und die aktive Betriebsleitungsregel, die durch Gestaltung des Betriebes die Plastik in die sonst zwangsläufig ablaufenden Vorgänge hineinbringt.

the growth and regeneration of organisms. Its task is to keep the body mechanism operational."[229] (von Uexküll 1929, p. 39)

It is here that we find the mechanizer: the active plan, this life factor in the organism: "It can therefore be described as a *mechanizer.* "[230] (von Uexküll 1929, p. 39). It corresponds to the active plans and rules of organisms "(…) the word mechanizer that I chose for the active functional rule (*Funktionsregel*), which is synonymous with a functional building plan."[231] (von Uexküll 1928, p. 205). It confers to organisms their autonomous nature: "Since the performance shape (*Leistungsform*) of a cell is subject to an active plan, the mechanizer, it is to be termed an autonomous entity (*Autonom*)"[232] (von Uexküll 1928, p. 205).

Here we notice the subtle difference between the plans in the case of organisms and of machines. They can be identical, as both correspond to the *Bauplan* of an organism, expressing their spatial arrangement and functionality. "(…) I can define the mechanizer as an active building plan without fear of being misunderstood. Even when I speak of the passive building plans of mechanisms, they are identical to their operational plans (*Betriebspläne*). The operational plan (*Betriebsplan*) of a rotating windmill, for example, is quite identical to the building plan of a stationary mill."[233] (von Uexküll 1929, p. 39). But only in the case of organisms is it an active plan, or functional plan, where it guides the super-mechanical properties. "It is an operational plan (*Betriebsplan*) and not a space plan (*Raumplan*), the one that lies in the forms of organs"[234] (von Uexküll 1929, p. 39).

After the period of development, the regulative action of the mechanizer guides the super-mechanical properties of regulation and regeneration: "As soon as machines wear out or become damaged, their functional rule (*Funktionsregel*) cannot come to their aid, as is the case with living beings that host themselves their functional rules and at the same time have the

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[229] Ich behaupte nun, dass der Betriebsplan, der sich im Funktionskreis betätigt, ein aktiver Plan ist, der die Funktionen dauernd beherrscht. In ihm haben wir den gesuchten Lebensfaktor zu sehen, der sowohl für das Wachstum, wie für die Regenerationen der Organismen verantwortlich zu machen ist.
[230] Man kann ihn deshalb als *Mechanisator* bezeichnen.
[231] Das drückt sich in dem Wort Mechanisator aus, das ich für die aktive Funktionsregel gewählt habe, die gleichbedeutend ist mit funktionsfähigem *Bauplan.*
[232] Da die Leistungsform der Zelle einem aktiven Plan, dem Mechanisator unterstellt ist, ist sie als Autonom anzusprechen.
[233] (...) kann ich ohne Furcht, missverstanden zu werden, den Mechanisator als einen aktiven *Bauplan* definieren. Auch wenn ich von den passiven Bauplänen der Mechanismen rede, sind diese identisch mit ihren Betriebsplänen. Der Betriebsplan einer sich drehenden Windmühle z. B. ist durchaus identisch mit dem *Bauplan* einer stillstehenden Mühle.
[234] Dass es sich hierbei wirklich um einen Betriebsplan handelt und nicht um einen Raumplan, der in den Formen der Organe ruht, ist leicht zu beweisen.

material in the protoplasm that the mechanizer automatically uses as an active functional rule in order to mend the damage. From this behaviour of living beings we have gained the conviction that it is the functional rule itself that is capable of forming frameworks (*Gefüge*). This view was confirmed by the behaviour of unicellular protoplasmic animals, which themselves form and destroy their necessary structure in accordance with the functional rule that governs the actions of the structure. The digestion rule of Paramaecium caused the mouth, stomach, intestine and anus to come into being and to pass away, one after another."[235] (von Uexküll 1928, p. 146-147).The mechanizer thus has a clear active role in an organism: "The real task of the functional rule is therefore not merely to give a rule of functions, but rather to bring the body mechanism into shape and to maintain it in a form that enables it to function properly. This is why I prefer to call it the 'mechanizer'"[236] (von Uexküll 1928, p. 174).

8.B.4 – Summary

We have been referring to the organizer and the mechanizer as the steersmen – or managers – of the natural processes of organisms, meaning that they keep the course of events in conformity with plan (*Planmässigkeit*). How do they do it? Von Uexküll claims that these are active plans, "the plans by which living beings are governed (…) are essentially active and operative."[237] (von Uexküll 1928, p. 205), like the active rule of the operational steersman (*Betriebsleitungsregel*) which shapes functional operations (von Uexküll 1928, p. 208). Their role consists in constantly exerting this influence on living beings: "The general building plan represents, thanks to its constant influence on the autonomous cellular entities (*Zellautonome*), the operational steersman (*Betriebsleiter*) of machines."[238] (von Uexküll 1928, p. 205).

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[235] Sobald nun die Maschinen sich abnutzen oder beschädigt werden, kann ihnen ihre Funktionsregel nicht zu Hilfe kommen, wie das bei den Lebewesen der Fall ist, die ihre Funktionsregel selbst beherbergen und zugleich im Protoplasma das Material besitzen, das der Mechanisator als aktiv auftretende Funktionsregel selbsttätig benutzt, um die Schäden auszubessern. Wir haben aus diesem Verhalten der Lebewesen die Überzeugung gewonnen, daß es die Funktionsregel selbst ist, die fähig ist, Gefüge zu formen. Diese Ansicht wurde bestätigt durch das Verhalten der einzelligen Protoplasmatiere, die ihr notwendiges Gefüge selbst formen und wieder vernichten entsprechend der Funktionsregel, die die Handlungen des Gefüges beherrscht. So ließ die Verdauungsregel von Paramaezium nacheinander Mund, Magen, Darm und After entstehen und vergehen.

[236] Die eigentliche Aufgabe der Funktionsregel besteht also nicht bloß darin, eine Regel der Funktionen abzugeben, sondern vielmehr darin, den Körpermechanismus in die Form zu bringen und in ihr zu erhalten, die ein fehlerloses Funktionieren ermöglicht. Deshalb ziehe ich es vor, sie den „Mechanisator" zu nennen.

[237] Die Pläne, von denen die Lebewesen beherrscht werden, sind hingegen ihrem Wesen nach tätig und wirksam.

[238] Der allgemeine *Bauplan* vertritt, dank seines dauernden Einflusses auf die Zellautonome, den Betriebsleiter bei den Maschinen.

In the case of the first time plan, namely development, morphogenesis of organisms is provided by the active rules and plans of genesis, expressing the *Bauplan* in the form of the framework: "A living being, which derives its framework from the germ, has no master builder (*Baumeister*), but follows the temporal building rule (*zeitliche Bauregel*) or the developmental plan (*Erbauungsplan*) directly. The building plan represents the client for him. The developmental plan is not a mere guide to building in living beings, which one can follow or ignore, depending on whether one thinks it is right or wrong, but it itself masters the building and is always correct, because it itself directs the construction. The developmental plan of living beings is an independent natural law, or rather a command of nature, to which the plastic material readily complies like iron to magnetism"[239] (von Uexküll 1922, p. 138).

Later, in the second time plan, the active *Bauplan* and the active functional rule correspond to the mechanizer, which has the role of regulating organisms, like the builder does with machines: "In addition to the plan (*Plan*), which serves to maintain the metabolism in an individual autonomous cellular entity, each autonomous entity is dominated by the general building plan, which assigns it its place in the overall operation. (…) It can also be referred to as the active functional rule (*Funktionsregel*) or, in short, as a mechanizer (*Mechanisator*)."[240] (von Uexküll 1928, p. 200).

A crucial question now presents itself: "How are all of the steersmen – or managers – and active plans and rules able to influence the cell protoplasm? How does this connection materialize?". The answer has already been introduced in Chapter 4: it is through the action of intermediary factors, namely impulses.

8.C – Impulses

[239] Das Lebewesen, das sein Gefüge aus dem Keim herleitet, besitzt keinen ausserhalb stehenden Baumeister, sondern folgt unmittelbar der zeitlichen Bauregel oder dem Erbauungsplan. Bei ihm vertritt der Bauplan den Bauherrn. Der Erbauungsplan ist im Lebewesen keine blosse Anleitung zum Bauen, die man befolgen oder unterlassen kann, je nachdem, ob man sie für richtig oder falsch hält, sondern er selbst beherrscht den Bau und ist immer richtig, weil er selbst den Bau richtet. Der Erbauungsplan der Lebewesen ist ein selbständiges Naturgesetz oder besser gesagt ein Naturbefehl, dem sich das bildsame Material ohne weiteres fügt wie das Eisen dem Magnetismus.

[240] Neben dem Plan, der zur Erhaltung des Stoffwechsels im einzelnen Zellautonom dient, wird jedes Autonom von dem allgemeinen *Bauplan* beherrscht, der ihm seinen Platz im Gesamtbetrieb zuweist. Der allgemeine *Bauplan* vertritt, dank seines dauernden Einflusses auf die Zellautonome, den Betriebsleiter bei den Maschinen. Er kann auch als die aktive Funktionsregel oder kurz als Mechanisator bezeichnet werden.

The other type of intermediate factor is the impulse. Providing the mediation between the guidance of the *Bauplan* and natural events in organisms. Due to this role, impulses have a particular nature, which allows them to connect the two levels: "We must attribute to impulses an immaterial character which enables them, on the one hand, to initiate new causal series, but, on the other, places their becoming effective under the control of a rule that is in conformity with plan"[241] (von Uexküll 1928, p. 149). They thus provide mediation because they are not material elements of the organism: "Impulses influence the cell protoplasm, but they are not a material component of the cell. Being in conformity with plan means that they obey a rule that is fixed in time and space, but they are themselves non-material" (von Uexküll 1926, p. 230). They are thus "(…) non-spatial promoters of spatial processes"[242] (von Uexküll 1928, p. 166). "From the perspective of plan, all we see are impulses which obey an extra-material rule" (von Uexküll 1926, p. 219). Additionally, impulses are not fixed to a definite position in space, and may easily be connected up with other impulses into a system (von Uexküll 1926, p. 215). "As an auxiliary concept, connecting the rule of shaping with that of substance-forming, I have introduced the impulse. The rule of shaping thereby becomes an impulse-system, extended in space and influencing matter at different places." (von Uexküll 1926, p. 291-292).

What is the relationship between impulses and the steersmen (*viz*. the organizer and the mechanizer)? First, we need to see how impulses appear in two main phases in the life of an organism: "We already know that impulses can obey two rules, because the rule of genesis (*Entstehungsregel*) governs impulses in the embryo, the functional rule (*Funktionsregel*) impulses in adults. I have already pointed out the relationship between the rule of genesis and the functional rule and have shown that in the case of the amoeba, the two rules together govern the formation of the pseudopodia. In the case of more complex animals (*gefügte Tiere*), however, the rule of genesis prevails in the first phase of life."[243] (von Uexküll 1928, p. 189-90). We should therefore ask: What roles do impulses play both A) in the development and B) in the maintenance of organisms?

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[241] (...) müssen wir den Impulsen einen immateriellen Charakter zuschreiben, der sie einerseits wohl befähigt, neue Kausalreihen zu beginnen, der aber andererseits ihr Wirksamwerden unter die Herrschaft einer planmäßigen Regel stellt.

[242] (...) sie sind unräumliche Veranlasser räumlicher Vorgänge.

[243] Daß die Impulse zweien Regeln gehorchen können, wissen wir bereits, denn die Entstehungsregel beherrscht die Impulse im Embryo, die Funktionsregel die Impulse im Erwachsenen. Ich habe auf die Beziehungen zwischen Entstehungsregel und Funktionsregel bereits hingewiesen und gezeigt, daß bei den Amöben die beiden Regeln gemeinsam die Bildung der Pseudopodien beherrschen. Bei den gefügten Tieren dagegen waltet im ersten Lebensabschnitt die Entstehungsregel allein.

8.C.1 – Time of Becoming

In Chapter 4, we saw how von Uexküll argues that in development there cannot be a starting structure in the germ, either a mechanical or chemical one. Alternatively, the events of morphogenesis are guided by the action of what he terms impulses: "This rule [guiding cell division], however, cannot be referred to a hidden framework, because the hypothetical hidden framework must likewise divide and duplicate itself, – a process that is just as insoluble mechanically. There remains no course open for us but to recognize that here before our eyes a process is going on that is accomplished, not through mechanical compulsion, but through active invasion by a super-mechanical design. Following the line we have pursued up to now, we shall assume the invasion by separate impulses, which we connected together into a system" (von Uexküll 1926, p. 289).

The successive invasion of impulses (impulse-sequence) organizes the elements of the germ-cell. "The direct influence of the impulses on the protoplasm is specifically different from the reciprocal influence that other natural forces exert on one another; for the impulses, which do nothing but organise, act on physical and chemical factors already present in the protoplasm" (von Uexküll 1926, p. 355). As we saw before, this factor is the ferment, which is "activated" by an impulse, giving rise to the gene (von Uexküll 1926, p. 217). Thus, a new factor is produced, connecting the plan with the protoplasm: "A gene must be considered a natural factor that, on the one hand, engages with the mechanical gear of the protoplasm [as an] ordering and structure-forming [factor] and on the other hand, is in a super-mechanical and according-to-plan relationship with the other genes"[244] (von Uexküll 1913a, p. 99).

The guidance of the construction of the framework in the protoplasm therefore occurs through a consistent invasion of impulses which imprint the plan into the material (von Uexküll 1926, p. 197). Here we find true epigenesis and not the unfolding of a pre-existing structure: "The germ and the embryo are unfinished structures, which are transformed into completed frameworks only through invasion by impulse after impulse, working in accordance with plan. By formation of new folds, the simple becomes complex" (von Uexküll 1926, p. 262).

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[244] Ein Gen ist als ein Naturfaktor anzusehen, der einerseits in das mechanische Getriebe des Protoplasmas ordnend und strukturbildend eingreift, andererseits mit den anderen Genen in einem übermechanischen, planmäßigen Zusammenhang steht (…)

Ultimately, it is the plan that directs these steps, since impulses act in conformity with plan, even if the plan has not yet materialized as the framework in the individual: "Thus, in the final analysis, it is the development plan (*Erbauungsplan*), i.e. an immaterial factor, which dominates the autonomous cellular entities (*Zellautonome*) and prescribes their course of development (*Bildungsgang*) according to the position they occupy in the respective body system."[245] (von Uexküll 1928, p. 172). This coordinating action by impulses was observed by Hans Spemann in his experiments: "Again, it is the results of Spemann's research that shed light on these facts. Spemann was able to show that with the start of gastrulation in Triton's upper Blastopore, an 'organizational centre' emerges, from which, as he puts it, 'differentiation currents' emanate which force the new design direction on the previously indifferent cells of the outer cotyledon. The new impulses rush from cell to cell, as I richly expressed, in order to force the new technical step on them"[246] (von Uexküll 1922, p. 157).

8.C.2 – Time of Being

As functioning starts, organisms begin working mechanically. "The completed framework, working in accordance with plan, does not show the slightest departure from causality" (von Uexküll 1926, p. 230). Thus, it appears as if the impulses no longer have a part to play: "The impulse-systems have no direct influence on the running of the cart, since they are suited only for the production of framework, and have lost all influence on the framework itself" (von Uexküll 1926, p. 292).

However, we can observe that they are required mostly for regeneration of injured parts of the organism. This is possible because not all protoplasm is transformed into the framework. "Over time, genes are lost, the effect of impulses becomes more restricted; the organism retains reserve-plasm which does not enter into the framework (von Uexküll 1926, p. 212). Consequently, impulses can still act through the remaining genes. "Any cell can take up any position within the same germinal area, since its gene-content is the same. With the critical point this ceases (…). But it has been shown that although, especially in the lower animals,

[245] Somit ist es letzten Endes der Erbauungsplan, d. h. ein immaterieller Faktor, der die Zellautonome beherrscht und ihnen je nach der Stelle, die sie im jeweiligen Körpersystem einnehmen, ihren Bildungsgang vorschreibt.
[246] Wiederum sind es die Ergebnisse der Forschungen Spemanns, die auf diese Tatsachen Licht werfen. Spemann konnte zeigen, dass mit Beginn der Gastrulation bei Triton in der oberen Urmundlippe ein „Organisationszentrum" auftritt, von dem aus, wie er sich ausdrückt, ‚Differenzierungsströme ausgehen, die den bisher indifferenten Zellen des äusseren Keimblattes die neue Gestaltungsrichtung aufzwingen. Von Zelle zu Zelle eilen die neuen Impulse, wie ich reich ausdrückte, um ihnen den neuen technischen Schritt aufzuzwingen.

cells with regard to their framework are just as definitely formed as in the higher animals, they still bring with them a large reserve of genes, which permit reconstruction to a very considerable extent." (von Uexküll 1926, p. 297). Through the action of impulses, a new framework is produced, repairing the injury. In summary: "As soon as the framework is completed and the function sets in as a purely material process, the control over impulses passes from the rule of genesis to that of function; this comes to the rescue when there is any injury, and, also with the help of the genes, carries out the repairs; in addition it controls the growth of the formed but not yet full-grown animal" (von Uexküll 1926, p. 235).

Now the crucial question remains: What is the connection between the impulses and the steersmen? We can see that they have a similar role in maintaining the organism in conformity with plan. But how are these two factors related?

As mentioned before, the action of impulses reveals the rule of the organism: "In all of these cases [activities of unicellular organisms] we found that it is the functional rule (*Funktionsregel*) that governs the impulse-sequence (*Impulsfolge*) in the protoplasm. It was therefore reasonable to assume that the functional rule (*Funktionsregel*) guides *ab ovo* the entire structure of the organs."[247] (von Uexküll 1928, p. 147). Additionally, in organisms the steersmen control the rules: "(…) the case with living beings that host themselves their functional rules (*Funktionsregeln*) and at the same time have the material in the protoplasm that the mechanizer automatically uses as an active functional rule (*Funktionsregel*) used to mend the damage."[248] (von Uexküll 1928, p. 146).We could therefore say that the impulses are under the guidance of the steersmen: "This is why the picture of the body machine is necessarily incomplete if one neglects the autonomous entities (*Autonome*) and the impulses which are responsible for the operational steering – or management (*Betriebsleitung*)"[249]. (von Uexküll 1928, p. 206). This control takes place in each time-phase of an organism: First the control is performed by the organizer (*Bauleiter*) and later by the mechanizer (*Betriebsleiter*). These steersmen can be detected in the form of the active plans and rules of the organism.

[247] In all diesen Fällen fanden wir, daß es die Funktionsregel ist, die die Impulsfolge im Protoplasma beherrscht. Es lag daher nahe, anzunehmen, daß die Funktionsregel den ganzen Aufbau der Organe vom Keim an leitet.
[248] (...) wie das bei den Lebewesen der Fall ist, die ihre Funktionsregel selbst beherbergen und zugleich im Protoplasma das Material besitzen, das der Mechanisator als aktiv auf tretende Funktionsregel selbsttätig benutzt, um die Schäden auszubessern.
[249] Deshalb ist das Bild, das man sich von der Körpermaschine macht, notwendigerweise unvollständig, wenn man die Autonome und die in ihnen waltenden Impulse, denen die Betriebsleitung obliegt, vernachlässigt.

8.D – The Natural Factor

At the start of section 8.B we asked two questions: First: how do the intermediary factors (impulses and steersmen) affect the processes in an organism? And second: how are they under the guidance of the *Bauplan*? We started by analysing the first question and saw how both affect living beings in their two time-phases, and how they are connected to each other.
Now we want to move on to the second question: understanding how both factors (impulses and steersmen) act in conformity with the *Bauplan*. We will see that, as we do this, a new level in von Uexküll's biological theory is revealed.

Previously we saw that the impulses guide both time-phases in the lives of living beings: "(…) the rule, which in itself is occasional, acts on matter and gives it form. And, as we have seen for 'impulses', its modality of intervention is twofold: on the one hand it guides the formation of fixed structures, on the other it can intervene directly (in an occasional manner, as in the regeneration of tissue, or in a systematic manner, as in the amoeba)." (Brentari 2015, p. 122). "This way of considering things permits us to say of the impulse-systems that they are 'imperative' in respect of form, which they always relate to the development or maintenance of the individual." (von Uexküll 1926, p. 354). Similarly, the genesis-regulator (organizer, or *Bauleiter*) and the function-regulator (mechanizer, or *Betriebsleiter*) maintain an organism in conformity with plan during morphogenesis and its active life. "The plans by which living beings are governed, on the other hand, are essentially active and operative. This is expressed in the word organizer, [the word] Spemann chose for the plan that rules the budding (*Sprossung*), and in the word mechanizer, the one I chose for the active functional rule. Both act according to plans, whereas in the case of living beings we are dealing with action plans."[250] (von Uexküll 1928, p. 205).

[250] Die Pläne, von denen die Lebewesen beherrscht werden, sind hingegen ihrem Wesen nach tätig und wirksam. Das drückt sich im Wort Organisator aus, das Spemann für den die Sprossung beherrschenden Plan und in dem Wort Mechanisator aus, das ich für die aktive Funktionsregel gewählt habe, die gleichbedeutend ist mit funktionsfähigem *Bauplan*. Bei Maschinen würde der Organisator dem Bauleiter und der Mechanisator dem Betriebsleiter entsprechen. Beide handeln nach Plänen, während wir es bei den Lebewesen mit handelnden Plänen zu tun haben

As we mentioned above, the role of the organizers and mechanizers, expressing and maintaining the *Planmässigkeit*, is detected in the form of active plans and rules during the different phases in the lives of organisms. Von Uexküll writes: "(…) the word mechanizer (*Mechanisator*) that I chose for the active functional rule (*Funktionsregel*), which is synonymous with a functional building plan (*Bauplan*)"[251] (von Uexküll 1928, p. 205). In a similar fashion, impulses can also be understood as active plans and rules: "The self-regulated impulse-sequence (*Impulsfolge*) represents the active building plan (*Bauplan*), which here quite clearly makes a certain selection from the bundle of fermentative cells that offers all possibilities and imposes a certain sequential order on the selected ferments"[252] (von Uexküll 1928, p. 123). And also: "The infallibility with which protoplasm, wherever it is at work, is able to improve and repair the framework, shows that its impulse-sequence corresponds to a definite rule, which in this way governs the physico-chemical processes. We can prove that the super-mechanical factor operative in the protoplasm must be a rule, bound indeed to a definite place in space by the material with which it works, but in itself super-spatial, since it disposes of the spatial arrangement of the framework." (von Uexküll 1926, p. 153).

Ultimately, von Uexküll claims that these distinct factors are all different forms of expression of a natural factor (*Naturfaktor*) or natural force (*Naturkraft*). Expressed in the subject and the steersmen: "The subject is distinguished from the implement [type 2 object] by possessing an autonomous function-regulator, and it also has an autonomous rule of genesis; this being likewise a natural factor, may be called genesis-regulator" (von Uexküll 1926, p. 235). And also in the impulses: "This natural factor (*Naturfaktor*) is also subdivided, as it represents a sequence of impulses (Impulsfolge)."[253] (von Uexküll 1928, p. 55). Von Uexküll is pointing to a new level of organization, as Brentari points out: "Philosophically, another force could be hypothesized: 'vital energy' [*Lebensenergie*], 'natural factor' [*Naturfaktor*], or 'natural force' [*Naturkraft*]" (Brentari 2015, p. 122).

The factor itself is not new to us. It corresponds to the conformity with plan. But it highlights the fact that we are no longer dealing with neutral and passive categories. This factor is an active one, which dynamically affects the phenomena of living beings. It is expressed in

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[251] *idem*

[252] Die in sich geregelte Impulsfolge stellt den aktiven *Bauplan* dar, der hier ganz deutlich aus dem alle Möglichkeiten bietenden Fermentbündel im Kern eine bestimmte Auslese trifft, und den erwählten Fermenten eine bestimmte Reihenfolge aufzwingt.

[253] Dieser Naturfaktor ist ebenfalls gegliedert, da er eine Impulsfolge darstellt.

organisms' plans and rules: "We called this natural force (*Naturkraft*) conformity with plan (*Planmässigkeit*) because we can only follow it with our apperception if it combines the various details into a whole with the help of rules. Higher rules, which also combine temporally separate details, are generally called plans, regardless of whether they are based on human intentions or not. Instead of conformity with plan (*Planmässigkeit*) we can just as well say functionality (*Funktionsmäßigkeit*), harmony (*Harmonie*) or wisdom (*Weisheit*). The word does not matter at all, but only the recognition of the existence of a natural force (*Naturkraft*) that binds according to rules. Without the recognition of this natural force (*Naturkraft*), biology remains an empty delusion."[254] (von Uexküll 1928, p. 144).

All of the factors that we have introduced work in conformity with plan: "Conformity with plan is the guiding law of the impulse-system, by the aid of which it organises all living matter into subjects, and the coming and going of which it controls, as well as the relations of the subjects to one another and to non-living Nature" (von Uexküll 1926, p. 319)

We are not therefore moving away from the main focus of this investigation. The study of the natural factor is the study of conformity with plan (*Planmässigkeit*). The above mentioned passage from von Uexküll's *Theoretical Biology* says it all: "If by biology we understand the doctrine of conformity with plan in the world of living things, we shall realise that one of the fundamental inquiries of the science [sic] must be into the nature of this conformity" (von Uexküll 1926, p. 270). Von Uexküll never stops insisting on this point: "this brings us to the new natural factor (*Naturfaktor*), the plan, the research of which has become the main task of biology"[255] (von Uexküll 1928, p. 233). "It is, of course, of paramount importance to learn more about this enigmatic natural factor (*Naturfaktor*)"[256] (von Uexküll 1909, p. 13).

Consequently, von Uexküll refers to the natural factor to describe the properties that are exclusive to life i.e. that go beyond the laws of causality. "This meant that a new scaffolding for biology became necessary; the previous scaffolding, which had been borrowed from

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[254] Diese Naturkraft haben wir Planmäßigkeit genannt, weil wir ihr nur dann mit unserer Apperzeption zu folgen vermögen, wenn diese die mannigfaltigen Einzelheiten mit Hilfe von Regeln zu einem Ganzen verbindet. Höhere Regeln, die auch zeitlich getrennte Einzelheiten verbinden, bezeichnet man allgemein als Pläne, ohne Rücksicht darauf, ob sie auf menschlichen Absichten beruhen oder nicht. Wir können statt Planmäßigkeit ebensogut Funktionsmäßigkeit, Harmonie oder Weisheit sagen. Auf das Wort kommt es gar nicht an, sondern nur auf die Anerkennung der Existenz einer Naturkraft, die nach Regeln bindet. Ohne die Anerkennung dieser Naturkraft bleibt die Biologie ein leerer Wahn.

[255] Damit stoßen wir auf den neuen Naturfaktor — den Plan, dessen Erforschung zur Hauptaufgabe der Biologie geworden ist.

[256] Es ist natürlich von höchster Bedeutung, etwas Näheres über diesen rätselhaften Naturfaktor zu erfahren (...)

chemistry and physics, was no longer sufficient. Because chemistry and physics do not know conformity with plan (*das Planmässige*) as a natural factor (*Naturfaktor*). Biology, however, consists in the establishment of a framework of theorems that recognize conformity with plan as the basis for life"[257] (von Uexküll 1928, p. VI). "In summary, one group of naturalists affirms that life is a special case of mechanics; but another sustains that life is an independent natural factor, that has its own law, which is precisely conformity with plan"[258] (von Uexküll 1913a, p. 156).

8.D.1 – Back to You, Hans

In summary, we have seen that von Uexküll's idea of teleology rejects the existence of a goal towards which processes or organisms are directed. Instead there is a "conformity with plan" (*Planmässigkeit*). As we quoted above: "Instead of seeing in it merely a rule stretching across time and space, men have spoken of 'purpose' and 'purposefulness' in Nature; and this introduced the idea of Nature as a sort of human being, foreseeing future events and acting accordingly. But just whereas conformity with plan is easiest to detect, we can find no trace of any such human-like being. It is advisable therefore to dismiss from biology, for all time, expressions such as 'purpose' and 'purposefulness'" (von Uexküll 1926, p. 270).

The "conformity with plan" is expressed in the *Bauplan*, more explicitly in the specific framework (*Gefüge*) of each individual. In machines this plan derives completely from the builder. All the actions of construction, maintenance and repair are done by the builder as well. In organisms, the *Bauplan* itself is active, meaning that organisms are autonomous, unlike machines. The conformity with plan guides the processes of organisms through the action of intermediary factors – steersmen and impulses – that interact with the protoplasm of living beings. Non-material impulses direct the natural processes in accordance with the *Bauplan*. Conversely, the manifestation of these factors points to the existence of a natural factor – one that is at the basis of super-mechanical properties.

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[257] Damit wurde ein neues Gerüst für die Biologie notwendig, das bisherige Gerüst, das man der Chemie und der Physik entliehen hatte, genügte nicht mehr. Denn Chemie und Physik kennen das Planmäßige als Naturfaktor nicht. Die Biologie besteht aber in der Aufstellung eines Gerüstes von Lehrsätzen, die das Planmäßige als Grundlage des Lebens anerkennen.

[258] Kurz zusammengefaßt, behauptet die eine Partei der Naturforscher, das Leben sei ein Spezialfall der Mechanik, die anderen aber, das Leben sei ein selbständiger Naturfaktor, der seine eigene Gesetzmäßigkeit besitzt, die eben die Planmäßigkeit ist.

In Driesch's biological theory, Entelechy seems to be playing a similar role. It is also a non-material agent directing the processes of morphogenesis of living beings. As we saw above, it acts by regulating the physico-chemical reactions in organisms.

Now, in von Uexküll's case, we know that all of these events are ultimately somehow accounted for in the *Bauplan*. Regardless of our ability to know this factor completely (as we will discuss later), von Uexküll has provided his case for the existence of an overall plan according to which living beings are arranged. This is his understanding of teleology.

What do we find in Driesch's ideas? What is there "at the end" of Entelechy? Before we move on to the study of the Uexküllian *natural factor*, let us therefore see how Driesch tackles this issue.

Chapter 9 – Driesch: The End of Entelechy

9.A – Individuality

As we hinted at the end of Chapter 3, Driesch drops the mechanistic view and the machine-theory of life in favour of vitalism, or dynamic teleology. It is here that he deals with teleology, or purposiveness in a deeper sense: "(…) by 'Vitalism' we mean the possibility, merely negative at first, that there may be processes in an organism which are *not* of the machine-like or 'mechanistic' type, and which may be said to be 'teleological' or purposeful in more than a merely formal sense. (Driesch 1914b, p. 5). According to Driesch, purposiveness or teleology can be generally defined in the following way: "such actions as experience shows to contribute directly or indirectly to a definitely desired end" (Driesch 1914a, p. 1). However, for Driesch teleology does not simply mean the apparent purposefulness of *single* events, but the description of a certain combination of temporal or spatial phenomena: "We ask 'for what purpose?' whenever we see anything happen that bears on the realisation of a certain typically combined whole, 'typical' either on account of any kind of symmetry or on account of its existence in indefinite exemplars" (Driesch 1908 Vol.2, p. 309). Purposiveness of organisms is expressed in their organization as a wholeness or totality.

What is this wholeness? As seen above, Driesch introduces Entelechy as the manifestation of the category of Individuality. This category describes the irreducibility of organisms to physico-chemical laws: their unity or totality is something different, not subsumed under these laws. This means that all single events that we may identify as 'finality' should be considered in the context of the manifestation of Entelechy: "We have proposed to apply the name of finality to those singlenesses in a manifestation of individuality that take the *place* of causes in the manner described, though they are not 'causes' pure and simple. In this way individuality 'implies' causality." (Driesch 1908 vol 2, p. 315).

Teleology, or purposiveness, is therefore a subclass of Individuality. Teleology is explained through the existence of individualizing or unifying causality: "If a system passes through several phases of becoming in succession, all controlled by unifying causality, we may speak of the *evolution* of the system: and every singularity of becoming that leads to the unity

as the final *end* may be called *purposive* or *teleological*. But the concepts of unity and of unifying causality are the more fundamental." (Driesch 1914a, p. 201).

Now we should ask: what is the end of Entelechy? It is, as a manifestation of Individuality, to produce the whole or totality: "To build up the organism as a combined body of a typical style is the task of Entelechy: Entelechy means the faculty of achieving a 'forma essentialis'" (Driesch 1908 Vol 2, p. 149). All purposes are for the production and maintenance of this totality: "Indeed every organic process, whether morphogenetic or physiological, is 'purposeful' for the reason that it serves to form and to preserve a specific constellation which occurs in indefinite exemplars, and whose specificity has no other reason than the existence of a previous specificity of the same type; for this reason and for no other an organic process is 'teleological'" (Driesch 1908 vol 2, p. 132).

9.B – Driesch's Natural Factor

As we just described, ultimately Driesch's understanding of teleology consists in attaining this wholeness or totality through the action of Entelechy: "Let us now call all processes leading to factual wholeness *teleological* or purposeful processes. (…) *There are* the individual organisms, each of them representing manifoldness in unity, *i.e.* factual wholeness, and *there are* processes, of at least three different kinds, embryological, restitutive and adaptive, leading to this wholeness *as if* the existence of this wholeness were their 'purpose'. They always lead to the wholeness; they have done so, and do so, and will do so, in innumerable cases." (Driesch 1914b, p. 4).

Now, as we saw in von Uexküll's biological theory, there is also an irreducible wholeness of organisms. And we saw that this wholeness is explained by the existence of a *Bauplan*, that is, a factor accounting for the organization of organisms. Additionally, we saw that in von Uexküll's view, the "information" provided in the *Bauplan* is relayed to the protoplasm through the action of intermediary factors, more specifically impulses.

Here we can stop and take a step back – it is hard to avoid noticing the similarities between these impulses and Driesch's Entelechy. Does Entelechy play the same role as Uexküllian impulses? If so, this means that in Driesch's biological theory we should also have a factor placed beyond the material composition of organisms to account for their wholeness . Hein also points it out: **"**Since the organism as organized possesses a 'wholeness' which is not

to be found in the aggregation of the individual constituents, there must be a cause of the 'wholeness' which is ontologically prior to the developmental process which leads to its realization. Every effect must have a cause which is prior to it and in which it is implicitly present. This is the rationale behind the introduction of the entelechy, and it denies the occurrence of novelty. The organizational factor must be accounted for as somehow pre-existent and independent of the matter which is organized." (Hein 1972, p. 170).

This observation suggests that we could consider Entelechy some kind of "intermediary factor" like von Uexküll's impulses and steersmen. All of them connect an organizational factor to the material elements of organisms.

Consequently, just as in the case of von Uexküll's ideas (cf. Section 8.B), this corollary raises two lines of questioning. We could ask first: how does Entelechy affect the processes in an the organism? And second: how does it relate to this putative "organizational factor"?

We have already responded to the first question in section 7.B.6. We have seen how Entelechy can affect the processes of organisms. Briefly, as we quoted above, it is able to "suspend for as long a period as it wants any one of all the reactions which are possible with such compounds as are present, and which would happen without Entelechy. And Entelechy may regulate this suspending of reactions now in one direction and now in the other, suspending and permitting possible becoming whenever required for its purposes" (Driesch 1908 Vol 2, p. 180).

So now we can focus on the second question. Here the emphasis is not on the relationship of Entelechy with an organism, but with a factor beyond Entelechy itself.

The activity of Entelechy leads to something new, specifically a new path of natural events: "Entelechy *uses* matter and material causality for its 'purposes'. A material system in space left to itself will behave differently from what it would do if controlled by entelechy." (Driesch 1908 Vol 2, p. 336). When we look at the suspending action of Entelechy, we see that the physico-chemical events are guided in a specific direction: "And entelechy may *regulate* this suspending of reactions now in one direction and now in the other, suspending and making possible becoming whenever required for its purposes." (Driesch 1908 vol.2, p. 180). We just saw that, in all cases of super-mechanical action, this "purpose" is the wholeness of an organism. However, a crucial question is raised here. Specifically, we have been referring to Entelechy's ability to guide the reactions in different directions. That is, a choice is being made.

As Smith puts it: “This implies a double power within the organism, for in addition to being able to stop one action, and later, of course, to allow it to resume by lifting the suspension, the entelechy would be able also to exercise control over a ‘choice’ of two different actions.” (Smith 1955, p. 201).

As Normandin and Wolfe point out, it becomes clear that somehow the end or purpose is playing a role in these events: “(…) ‘suspension in one direction or another’ offers a teleological sounding phrase – one direction or another – but in fact describes a retardation of processes that are already ‘going somewhere,’ due to their mechanical features. Stopping the flow of blood with a clot so that it takes one path rather than another seems very different from directing the blood towards that path. But Driesch would reply that the occasion of such suspension is prescient and does indeed bring about a goal – maintaining a steady state within the organism.” (Normandin and Wolfe 2013, p. 139).

We therefore reach the second of the questions we introduced above. How does Entelechy relate to its end, or, ultimately, the organizational factor?

First, Driesch is not arguing for some final cause directing the phenomena of life. We are not talking about the action of the “end” itself: “But what then of the famous ‘*causa finalis’*? Simply this, that the term is completely absurd without further explanation. In the first place, as we know, there is no *proper ‘causa’*; and in the second, how could the *end*, which is not yet reached but is *to be* reached, be an acting factor at all? The ‘end’ determines Entelechy to be what it is (…); but ‘the end’ does not act (…)” (Driesch 1908 vol 2, p. 315).

How is this choice therefore made? There has to be some way in which this purpose is anticipated beforehand. Additionally, Entelechy has to somehow be able to reach this goal. Driesch refers to these two characteristics as the “willing” and “knowing” in the activity of Entelechy: “We indeed are in a rather desperate condition with regard to the real analysis of the fundamental properties of morphogenetic, adaptive and instinctive entelechies: for there *must* be a something in them that has an analogy not to knowing and willing in general (…) *but to the willing of specific unexperienced realities*, and to knowing the specific means of attaining them.” (Driesch 1908 Vol.2, p. 142). What is Driesch talking about here?

9.C – Choosing the End

Let us briefly return to von Uexküll's biological theory to see how he deals with this issue. In von Uexküll's view – as we have seen through a series of examples – the morphogenetic events and actions of organisms are guided not by goals but by plans (cf. section 8.A). He emphasizes this as follows: "It should therefore be our first concern to extinguish the will-o'-the-wisp of the goal in our observation of environments. This can only happen inasmuch as we consider the vital expressions of animals from the vantage point of the plan."[259] (von Uexküll 1956, p. 60). Additionally, von Uexküll states that an organism is neither a conscious planner, nor able to perceive its plan (Section 4.B.4). As Weiss puts it: "The animal perceives various data, but it does not perceive the plan. Besides, in the life, for example, of an embryo, where there definitely is a plan, there is as yet no perception at all. We should therefore not think of a plan as of a purpose" (Weiss 1948, p. 55). Overall, these conclusions tell us that, according to von Uexküll, organisms do not have a psychological anticipation of their end, of their *Bauplan*.

What can we say about Entelechy? Is there a conscious anticipation of its end or not?

According to Driesch, Entelechy (in its different manifestations) does not have any kind of "experience" from which to draw from as it acts: "(…) the entelechies of morphogenesis and of instinct are wanting in the criterion of the 'historical basis of reacting' (…)" (Driesch 1908 Vol.2, p. 139). Driesch calls this type of action "primary": "The manifestations of these entelechies are 'primary': they occur either not at all or *perfectly* the very first time; all sorts of restitutions and of instincts are instances of this primariness" (Driesch 1908 Vol.2, p. 140).

That is, as we mentioned above, Driesch argues that Entelechy should have some ability to "will and know" its end. Yet the crucial aspect is that it does not arise from an actual "knowledge" of its end, as happens, for example, with our acting. Only our conscious actions are truly purposive in this sense: "This subclass of constructive individuality, apparent in *my* acting, alone deserves the names of *finality* in the proper sense, or purposefulness or teleology: here alone is the '*finis'* consciously anticipated in a clear and distinct manner, and here alone does it account for the special type of each *single* phase of what the 'individual' factor performs. (Driesch 1908 Vol.2, p. 313).

[259] Es muß daher unsere erste Sorge sein, das Irrlicht des Zieles bei der Betrachtung der Umwelten auszulöschen. Das kann nur dadurch geschehen, daß wir die Lebensäußerungen der Tiere unter dem Gesichtspunkte des Planes ordnen.

Driesch calls this type of action, which draws from experience, *secondary* "willing and knowing". In this sense, instinctive actions (unconscious ones), for example, are not *secondary* but *primary* "willing and knowing": "If the righting reactions were instinctive, then only primary 'knowing and willing' would come into account" (Driesch 1908 Vol.2, p. 141, footnote).

According to Driesch, there have to be agents in nature possessing this kind of *primary* activity: "But it is my firm conviction that we cannot avoid the admission of vitalistic autonomic agents possessing no experience, i.e. no 'secondary' faculties, and yet endowed with specific knowing and willing: indeed, as far as morphogenesis and physiological adaptation and instinctive reactions are concerned, there must be a something comparable metaphorically with specified knowing and willing, but without experience." (Driesch 1908 Vol.2, p. 143)

The activity of Entelechy is therefore only said to be purposive or teleological in this sense. Not as a *secondary* but a *primary* type of action: "In a certain sense we even might apply the name of finality to each *single* performance of such a totality of occurrences as acting is. You will remember in this connexion that with regard to morphogenetic entelechy it was only by descriptive analogy that we applied the words 'willing', 'judging', and 'knowing'." (Driesch 1908 Vol.2, p. 313).

9.D – What Is There to Know?

With the distinction between primary and secondary willing and knowing, Driesch's claims on the purposiveness of Entelechy become clearer, at least on more a superficial level: "In this way, regarding it only as a kind of description, I see no fundamental difficulty in speaking of entelechy's primary 'knowing and willing'; at least no other description of what happens seems to be derivable from any species of analogy." (Driesch 1908 Vol.2, p. 145). There is not a conscious anticipation of its end in the "anthropomorphic" sense of the term.

However, the issue is that, even if we have a clearer picture of our field of battle, we still do not know where this is leading us to: "And we are by no means able to understand such a specified primary knowing and willing in even the slightest degree." (Driesch 1908 Vol.2, p. 142). We see the path, but we still do not know where it takes us because the purpose of Entelechy is not subsumed into Entelechy itself. "It is for this reason that all vital becoming strikes us as something that is new and primordial, though in fact the part played by Entelechy

does not imply creation but implies regulatory admission of pre-established possibilities only. This final statement implies that Entelechy is *alien* not only to *matter but also to its own material purposes*." (Driesch 1908 Vol 2, p. 336).

There still has to be something beyond the manifestation of Entelechy – something like an organizational factor. "This, in fact, is a point of great importance: the concept of a 'self-purpose' is contradictory in itself, even formally; a 'purpose' as we know from a former discussion, is always a certain state of the surroundings that 'ought to be' with regard to a subject external to it." (Driesch 1908 Vol 2, p. 336).

Driesch adds: "Of course, we must be careful about *what* has to be 'known' and 'judged' and 'willed'." (Driesch 1908 Vol.2, p. 143). So, *what* is there?

Unfortunately, we seem to have reached a dead end on this question: "Where this controlling action on the part of entelechy comes from, we do not know. We are therefore *absolutely unable to say anything whatever about the origin of life*. (Driesch 1914b, p. 38). In other words: "It is useless to speak about the origin of entelechial suspension in nature; useless, i.e. to discuss the *origin of life*. It is absolutely impossible for us to say anything definite on this subject." (Driesch 1914a, p. 205). In summary: "Unfortunately, as will be seen later on, we are unable to escape this *regressus ad infinitum* in any way; at least we know nothing about a 'first' and really primordial act of suspension of inorganic becoming on the part of entelechy." (Driesch Vol.2, p. 181).

How can we proceed from here? Let us return to von Uexküll and ask for some assistance.

Chapter 10 – Von Uexküll: Uncovering the Natural Factor

As we introduced above, in the biological theories of both Driesch and von Uexküll there is some kind of organizational factor, or natural factor, that controls the action of Entelechy (in Driesch's case), and the intermediary factors, the steersmen and impulses (in von Uexküll's case). How can we unlock this relationship?

The key to the analysis of von Uexküll's natural factor is to return to the decisive characteristic of his biological theory that we analysed in chapter 5.

The first aspect is that in von Uexküll's theory an animal is not limited to its body, and is not thus disconnected from its surrounding world. A subject is intrinsically connected its environment – there is an organism-*Umwelt* unity. Secondly, the world should not be understood as an objective but a subjective one. That is, a subject, described as an organism-*Umwelt* unity, constructs its own world. Von Uexküll puts it in a nutshell: "*All reality is subjective appearance*. This must constitute the great, fundamental admission even of biology. It is utterly vain to go seeking through the world for causes that are independent of the subject; we always come up against objects, which owe their construction to the subject" (von Uexküll 1926, p. XV, his emphasis). On the one hand, therefore, we cannot move out of this subjectivity: "By objective phenomena we understand, in general, those that take place between objects without consideration of any subject. But we have to confess now that we know absolutely no such phenomena, for it is always our own subject that observes the phenomena, and this subject can never be switched off"[260] (von Uexküll 1913a, p. 197-198). On the other hand, this also means that these worlds are closed off to different subjects: "Each one of us is only authorized to say: 'my perceptual world consists of my objects' and only when we are similar as subjects is it permissible to talk about equality in our objects"[261] (von Uexküll 1913a, p. 143).

[260] Unter objektiven Vorgängen verstehen wir im allgemeinen solche, die sich unter den Objekten abspielen, ohne Rücksicht auf irgendwelches Subjekt. Nun müssen wir aber zugestehen, daß wir solche Vorgänge gar nicht kennen, denn immer ist es unser eigenes Subjekt, das die Vorgänge beobachtet, und dieses Subjekt läßt sich nimmer abschalten.

[261] Jeder von uns ist allein berechtigt, zu sagen: „Meine Merkwelt besteht aus meinen Gegenständen", und nur soweit wir als Subjekte gleich sind, dürfen wir von der Gleichheit unserer Gegenstände reden.

Beyond this clarification, there is a second decisive aspect. This subjective world is a total world, a *particular kind* of a *totum quod non est pars alterius* (a whole which is not part of another). The "soap-bubble" of a subject is therefore a "total totality"; there is nothing beyond it. It contains the soap-bubbles of all other subjects (which are total worlds in themselves).

This is the basis for von Uexküll's biological theory: "When we recognise that there is another law beyond the causal one, the law of conformity with plan, we realize that there are as many worlds as there are subjects, which are not absolute but are worlds of appearance, and are intelligible only when connected with the subjects. This is the perspective of biology." (von Uexküll 1926, p. 71).

How does this affect the possibility of knowing the natural factor (*Naturfaktor*)? Von Uexküll's subjective view shows that we cannot know beyond the phenomenal experience of our? organism. As Buchanan puts it: "the reality we know and experience is ultimately what we subjectively perceive in the world. There is no objective reality in the form of objects, things, or the world; there is nothing outside of the individually subjective experiences that create a world as meaningful." (Buchanan 2008, p. 13). This means that the organizing factors of nature cannot be known directly. They are inaccessible to us. Harrington hits the mark when she writes: "Bowing to the limits of human knowledge, Uexküll concluded that science would never be able to visualize the 'natural factors' directly responsible for the spontaneous creativity and intelligence of living processes" (Harrington 1996. p. 52). In short, we are restricted to our subjectivity. "We can no longer get by with the natural factors (*Naturfakoren*) we are familiar with if we can no longer speak of the one sun that shines in the sky, but of thousands of suns that shine down from all the most distant levels of foreign subjects. These suns do not act directly on each other, but indirectly through a foreign subject on our surrounding world (*Umwelt*)"[262] (von Uexküll 1928, p. 233). Von Uexküll's view on conformity with plan is closely connected with the subjective nature of his biological theory.

[262] Wir können nicht mehr mit den uns geläufigen Naturfaktoren auskommen, wenn wir nicht mehr von der einen Sonne reden dürfen, die am Himmel strahlt, sondern von abertausend Sonnen, die von all den fernsten Ebenen der fremden Subjekte herabscheinen. Diese Sonnen wirken nicht unmittelbar aufeinander, sondern mittelbar durch ein fremdes Subjekt auf unsere Umwelt

10.A – No Direct Knowledge

So far, we have been introducing the different elements that compose von Uexküll's biological theory. However we do not yet have all of the parts that need to be interconnected to produce the whole picture. We therefore need to complete this background of elements before we move on.

Considering the subjective category of Nature, how can we have any evidence of this natural factor in our world? The answer is that all that we can know of the natural factor is through its effects on the world. As Harrington affirms: "Nevertheless, much as deists of an earlier age had sought to read God's mind in His creation, so Uexküll believed that it was possible to observe and map the patterns of physical and chemical effects left behind by the 'natural factors' in any particular organism" (Harrington 1996. p. 52). According to von Uexküll, this is the role of the scientific disciplines, and biology is well suited to identify these effects: "There certainly are realities which remain inaccessible to investigation, and of which we are able to form only a very dubious image, deduced from their activities. But fundamentally biology, in so far as it is obliged to deal with the organising factors of Nature, is in exactly the same case as physics, which is able to judge of the unorganised forces of Nature that form its province only from their activities. But biology has a far more secure foundation than physics and chemistry" (von Uexküll 1926, p. 361). Brentari sums this issue up, in Kantian terms: "only the phenomenon is directly knowable, while the noumenon [the will, or natural factor], that should also be necessarily postulated, cannot be investigated but through its phenomenal effects." (Brentari 2015, p. 236).

What kind of hints does the natural factor leave in the phenomenal world? Von Uexküll claims the plans and rules are the last empirical level of factors that we can detect: "Neither the building plan (*Bauplan*) nor the construction rule (*Bildungsregel*) have anything to do with the real natural factor (*Naturfaktor*) which forces the physicochemical processes to take a special course. Rule and plan are only the form in which we recognize the effects of that natural factor (*Naturfaktor*)"[263] (von Uexküll 1909, p. 13). And it is easy to see what this means. Brentari says

[263] Weder *Bauplan* noch Bildungsregel haben das mindeste mit dem wirklichen Naturfaktor zu tun, welcher die physikalisch chemischen Prozesse zwingt, besondere Bahnen einzuschlagen. Regel und Plan sind nur die Form, in der wir die Wirkungen jenes Naturfaktors erkennen.

it all when he writes: “If, however, we keep in mind that, for Uexküll, the building-plan has the status of a subjective theoretical construct, then this affirmation implies a recourse to the mysterious teleological *Naturfaktor* that lies behind the building-plan itself. And thus, as Uexküll himself admits, empirical investigation comes to a halt.” (Brentari 2015, p. 82).

This means that biological inquiry is focused on the detection of the natural factor through the rules of the organism, which we have just described. “The whole direction of the organism, in the species and in the community as well as in the individual, lies in the hands of a super-mechanical natural power, which is to be recognised not only through rules but itself acts according to rules” (von Uexküll 1926, Pg. 318). Or as Brentari puts it: “In Uexküll’s conception of the organism, the rule is the last level that empirical inquiry can reach: despite being incorporeal, atemporal and immaterial (and so unobservable in itself), the rule is accessible through the effects it exercises on matter.” (Brentari 2015, p. 122).

How do the rule and plan affect living beings? As we just saw in the previous sections, we detect their activity through the “intermediate” factors, which connect the natural factor to the protoplasm of an organism. This is evident in the case of the impulses: “This natural factor (*Naturfaktor*) is also structured, as it represents a sequence of impulses (*Impulsfolge*).”[264] (von Uexküll 1928, p. 55). “We must recognize in the impulse-sequence a natural factor (*Naturfaktor*) lying outside the anatomical framework (*Gefüge*) of an animal, a factor which regulates the functioning, so that we shall now seek it in the protoplasm itself, which universally obeys it. This factor does not grip the framework (*Gefüge*) in any unregulated way, but with as great conformity with plan as do our impulse-rules (*Impulsregeln*) in governing our own actions”[265] (von Uexküll 1928, p. 99).

The intermediate factors, as an expression of the natural factor, are behind the autonomous nature of living beings, that is, they give rise to subjects. In fact, in some cases von Uexküll calls the impulse-systems subjects: “Impulse-systems, which we may call subject-plans, or, briefly, subjects, in their arrangement control the time-relations, not only during the genesis of the organism, but also throughout the rest of its life” **(**von Uexküll 1926 p. 324). “This individual is always a subject, because it forms a new world-centre. (…) Accordingly,

[264] Dieser Naturfaktor ist ebenfalls gegliedert, da er eine Impulsfolge darstellt.
[265] (...) daß wir in der Impulsfolge einen außerhalb des anatomischen Gefüges des Tieres liegenden Naturfaktor anerkennen müssen, der das Funktionieren des Tieres regelt, so werden wir ihn jetzt im Protoplasma aufsuchen, das ganz allgemein diesem Faktor gehorcht. Dabei greift dieser Faktor nicht planlos in das Gefüge des Lebens ein, sondern genau so planmäßig wie unsere Impulsregeln unsere eigenen Handlungen lenken.

the impulse-system, to the imperative of which an individual owes its development, must, from one aspect be described as a subject, because it creates a world-centre." (von Uexküll 1926, p. 354). He also refers to this guidance of impulses by a subject as a subject rule: "One must not be mistaken about one thing, that even such a highly complex organism will not live unless it is guided by a dominant plan and is connected by it to a permanent unity – a subject. I will call this dominant plan, which alone is capable of producing life, the subject rule (*Subjektregel*) or subject melody (*Subjektmelodie*). Since the ferment piano of the nucleus consists of nothing but independent factors, these can only be put into action by pure individual events, which are based on the subject rule. I have called these individual events of the subject rule 'impulses'"[266] (von Uexküll 1922, p. 140). Additionally, the subject is also the manifestation of the action of both steersmen: "The subject is distinguished from the implement [type 2 object] by possessing an autonomous function-regulator, and it also has an autonomous rule of genesis; this being likewise a natural factor, may be called genesis-regulator. Thus the subject, as the visible manifestation of the union of both these regulators, forms the most important natural factor in biology." (von Uexküll 1926, p. 235).

We can therefore see how the analysis of both the steersmen, the genesis-regulator and the function-regulator, and the impulses, corresponds to the study of a subject in biology. "The subject reveals itself to us first as an architect, and then as a director of affairs." (von Uexküll 1926, p. 230). The action of the intermediate factors is pivotal for the construction of each subjective world: "The command given by the super-mechanical impulse acts on the world like an enchanter's wand. By a stroke of magic, the sum of the impulses that appear creates around us the whole vast world of colour and sound" (von Uexküll 1926, p. 359).

Overall, the action of the natural factor is detected in the two phases of the life of an organism: "As an independent natural factor, the rule of genesis (*Entstehungsregel*) continues its prescribed course up to the critical point and no further. (…) The functional rule (*Funktionsregel*), however, works like a new broom that sweeps out everything that is useless

[266] Über Eines darf man sich keiner Täuschung hingeben, dass selbst ein solcher höchst verwickelter Organismus nicht lebt, wenn er nicht von einem beherrschenden Plan gelenkt wird und durch ihn zu einer dauernden Einheit – einem Subjekt verbunden wird. Diesen beherrschenden Plan, der allein befähigt ist, das Leben zu erzeugen, will ich Subjektregel oder Subjektmelodie nennen. Da das Fermentklavier des Kernes aus lauter selbständigen Faktoren besteht, können diese nur durch lauter einzelne Wirkungen, die yon der Subjektregel ausgehen, in Tätigkeit versetzt werden. Diese isolierten Wirkungen der Subjektregel habe ich „Impulse" genannt.

and only retains what is necessary. It is also an independent natural factor (*Naturfaktor*) (…)"[267] (von Uexküll 1928, p. 174). And this holds true for the first phase, namely for the development of organisms: "If we now place these factors (which are located outside the 'type 2 object' (*Gegenstand*) [in question] when 'type 2 objects' are developing) in the seed of a developing living being and recognize them as original natural factors, the otherwise insoluble contradictions disappear. The whole process of development then dissolves into a series of independent actions, which are kept in balance within and among themselves by impulse rules (*Impulsregeln*)."[268] (von Uexküll 1928, p. 159). "We have finally been able to establish that the impulse-sequence (*Impulsfolge*) also regulates the activity of the protoplasm, and thus expresses itself as an independent force of nature (*Naturkraft*), producing organs with a differentiated structure and making them disappear again."[269] (von Uexküll 1928, p. 99). But pretty much the same holds true later, for the functional phase: "Only from the circumstance that the process of formation in living beings unerringly brings about a functioning framework (*Gefüge*), can we draw the conviction that we have before us the working (*Walten*) of a planned natural factor (*eines planvollen Naturfaktors*)"[270] (von Uexküll 1928, p. 180). "Each functional circle is a unit, which as an active natural factor (*als aktiver Naturfaktor*) combines the structure and form of an animal subject with the objects of its environment."[271] (von Uexküll 1928, p. 200).

In short, we could say with von Uexküll: "The newly discovered natural force works rhythmically according to a definite plan, therefore it must be called a rule. The agency through which it materialised itself we called the impulse (…)" (von Uexküll 1926, p. 235). All empirical efforts are therefore targeted to find evidence of this super-mechanical factor in the

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[267] Die Entstehungsregel geht als selbständiger Naturfaktor ihren vorgeschriebenen Gang bis zum kritischen Punkt und nicht weiter. (...) Die Funktionsregel aber wirkt wie ein neuer Besen, der alles Unnütze auskehrt und nur das Nötige beibehält. Sie ist gleichfalls ein selbständiger Naturfaktor (...)

[268] Setzen wir nun diese Faktoren (die sich bei der Entstehung der Gegenstände außerhalb des entstehenden Gegenstandes befinden) in den Keim des entstehenden Lebewesens hinein und erkennen sie als ursprüngliche Naturfaktoren an, so schwinden die sonst unlöslichen Widersprüche. Dann löst sich der ganze Entstehungsvorgang in eine Reihe selbständiger Handlungen auf, die in sich und unter sich durch Impulsregeln im Gleichgewicht gehalten werden.

[269] Wir haben endlich feststellen hönnen, daß die Impulsfolge auch die Tätigkeit des Protoplasmas regelt, und sich dadurch als selbständige Naturkraft äußert, wobei sie Organe mit differenziertem Gefüge hervorbringt und wieder verschwinden läßt.

[270] Nur aus dem Umstande, daß der Entstehungsvorgang in den Lebewesen zielsicher ein funktionierendes Gefüge zustande bringt, schöpfen wir die Überzeugung, daß wir hier das Walten eines planvollen Naturfaktors vor uns haben.

[271] Jeder Fünktionskreis ist eine Einheit, die als aktiver Naturfaktor Gefüge und Gestalt des Tiersubjektes mit den Objekten seiner Umwelt zusammenschließt.

life of living beings. As Weiss puts it: “Uexküll, like other biologists before him and with him, has carried out experiments specially devised in such a way as to show by their outcome whether or not a plan is at work. The term plan does not imply any planning intelligence as the origin of the *Planmässigkeit* in nature. Uexküll appears to regard this problem as beyond the due limits of the biologist, for he has to restrict his statements to what he actually finds in nature.” (Weiss 1948, p. 48).

10.B – Beyond the Phenomena

So far we have seen that the detection of factors such as plans, rules and impulses points towards the existence of a higher element, one which von Uexküll calls the natural factor. However, it is decisive to remember that due to the subjective nature of von Uexküll’s biological theory it is not possible to know anything about this factor since we are restricted to our subjective events. That is, the organizing factor of nature cannot be detected beyond its actions on the phenomenal sphere. How, therefore, is it possible for von Uexküll to postulate the existence of a “supra-subjective” factor? How can we have any evidence of a factor that is above our phenomenal experience? The two claims do not seem to match: “Sketching the *Umwelten* of living beings – argues Uexküll – we get an image of the whole Universe. It is an entity possessing the status of a phenomenon, which we call nature. The building plans of these worlds, however, do not have anything in common with the *real Nature*. They are only a form in which we cognize its activities, nature itself remains unknown – concludes Uexküll (Uexküll 1921: 10). This statement seems shocking when considered in the context of the main thesis of Uexküll's conception: ‘all reality is a subjective phenomenon' and the proposition ensuing from it and arguing that any attempts of finding any reality beyond phenomena are useless.” (Pobojewska 2001, p. 330).

We thus have a dilemma to solve: how do we have evidence of a natural factor, if we cannot go beyond our own subjective experience? In order to support this claim, von Uexküll provides two main arguments, as Pobojewska puts it: “The fitting of living beings into the environment (*Umgebung*) in which they are found (Uexküll 1928: 318) and the planned co-ordination among the worlds of different living beings are, according to Uexküll, an expression of the

ultrasubjective planning of Life as such." (Pobojewska 2001, p. 331). Let us now take a closer look into these two arguments.

10.B.1 – *Einpassung*

The first argument is based on one of the crucial ideas that we introduced in chapter 5. That there exists a unity between the organism and its Umwelt. These are not two separate aspects. As we saw, this corresponds to the "subject" in the Uexküllian sense, and can be represented by a specific Bauplan.

In other words, Pobojewska states the following: "According to [von Uexküll's] opinion concerning the idea of '*Einpassung*', living beings are fitted into the environmental objects with which they did not have any earlier contacts (the object with its structure is inaccessible to the subject) and despite this fact they transform them into objects of their own *Umwelt* within the circle of the function (Uexküll 1922: 188)" (Pobojewska 2001, p. 331). We also introduced this concept in Chapter 5. What does it mean? Von Uexküll describes: "One such word seems to me to be "fittingness" (*Einpassung*), since it means nothing but the undisputed fact that organism and environment (*Umgebung*) fit one another"[272] (von Uexküll 1928, p. 217).

As mentioned before, this means that all objects that an organism encounters are included in the functional circle of the subject. Weiss puts it in a nutshell: "There is a perfect correspondence [fittingness] (*Einpassung*) between the animal's perceptive faculties and its Merkwelt [perceptive world], that is, those sensible characters within the world which alone are and need be accessible to it. There is, correspondingly, a perfect correspondence between its active faculties and its Wirkwelt [operative world]. A primitive animal, e.g. a tick, perceives very few qualities and reacts with very few actions. Higher animals have richer and more complicated worlds, though this by no means makes their functioning any surer. Each animal's specific world (*Umwelt*) differs from what we call its surroundings, which are noticeable to man (*Umgebung*)" (Weiss 1948, p. 49).

It is crucial to bear in mind that, according to von Uexküll, this fitting is not gradual, but complete from the first moment. There is never an incomplete adaptation: "Fittingness is

[272] Ein solches Wort scheint mir die „Einpassung" zu sein, da es nichts anderes besagt, als die unbestrittene Tatsache, daß Lebewesen und Umgebung ineinander passen.

always perfect, so far as the means at the disposal of an animal extend. If all organisms perfectly fit with their surrounding world (*Umwelt*), there is no such thing as gradual attainment of perfection; the perfection of fittingness exists everywhere from the very beginning."[273] (von Uexküll 1928, p. 217).

As mentioned before, von Uexküll uses this concept to dispel two ideas: first, that organisms and their *Umwelt* "did not suit one another from the beginning, and secondly, that the business of becoming suited requires a certain time" (von Uexküll 1926, p. 314). The fitting is always perfect: "As we know, this question has already been decided: there is no more or less fittingness (*Einpassung*)" (von Uexküll 1928, p. 217).

Secondly, fittingness between organisms and *Umwelt* does not come from the organisms adapting to the world around them. In his comment on von Uexküll, Heidegger stresses this point as follows: "An organism is not something independent in its own right which then adapts itself. On the contrary, the organism adapts a particular environment into it in each case, so to speak. The organism can adapt a particular environment into itself only insofar as openness for . . . belongs to its essence, and to the extent that, upon the basis of this openness for . . . which permeates its whole behaviour, a certain leeway is created within which whatever is encountered can be encountered in such and such a way, i.e., is capable of exerting an effect upon the animal through its disinhibiting function." (Heidegger 1995, p. 264). The outside world does not exert any influence on the organism: "The outside world (*Außenwelt*) offers living creatures a certain number of spatially and temporally separated characteristics to choose from, thus giving animals the opportunity to create therefrom a poorer or richer surrounding world (*Umwelt*) from them. It is, however, completely uninvolved in the choice that must be made by a living being without outside assistance."[274] (von Uexküll 1928, p. 218).

How does *Einpassung* point towards the natural factor? As we mentioned, this fittingness is based on the extension of the *Bauplan* beyond the body of an organism and towards the *Umwelt*: "Each various individual is different according to his changed building plan (*Bauplan*), but at

[273] Die Einpassung ist immer vollkommen, soweit die dem Tier zur Verfügung stehenden Mittel reichen. Wenn alle Lebewesen vollkommen in ihre Umwelt eingepaßt sind, so gibt es keine allmähliche Vervollkommnung, sondern die Vollkommenheit der Einpassung ist überall von vornherein vorhanden.

[274] Die Außenwelt bietet den Lebewesen eine bestimmte Anzahl räumlich und zeitlich getrennter Eigenschaften zur Auswahl dar und gewährt dadurch den Tieren die Möglichkeit, sich aus ihnen eine ärmere oder reichere Umwelt zu schaffen. Sie selbst ist aber völlig unbeteiligt an der Wahl, die vom Lebewesen ohne fremde Beihilfe getroffen werden muß.

the same time fully adapted (*angepasst*) to his environment (*Umgebung*). For the building plan largely creates by itself an animal's surrounding world (*Umwelt*). This insight, which I intend to prove step by step, can be regarded as the sole basis of biology. Only through it do we gain the proper understanding of how living beings organize and control the chaos of the inorganic world. Each animal in a different place and in a different way. Out of the immeasurable variety of the inorganic world, every animal chooses just what suits it, i.e. it creates its own needs according to its own kind of construction (*Bauart*)."[275] (von Uexküll 1909, p. 5).

In this complete and selective adaptation we should therefore find hints of a natural factor of organization, since this means that an organism itself and its connection to the surrounding world are both in conformity with plan: "As long as it has all of its mechanical and chemical properties, every living being is suited to its surrounding world (*Umwelt*), in perfect conformity with plan (*Planmässigkeit*)."[276] (von Uexküll 1928, p. 217). Weiss summarizes the gist of von Uexküll's claim: "(…) nothing essential in living nature can be brought about by mechanical causes. All fitting together gives evidence of the underlying plan. He refuses to admit of *Anpassung* (adaptation) and suggests in its place, as a basic biological concept, that of *Einpassung* (fitting together, fitting into). This means that in each animal species we find a structure precisely fit for the special task of that animal. The animal's body, habits and perceptions correspond exactly to the qualities of its world." (Weiss 1948, p. 52). In von Uexküll's words, as we quoted above: "We may assume 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" (von Uexküll 1926, p. 129).

10.B.2 – *Planmässigkeit* on Different Levels

Von Uexküll's other argument for the supra-natural factor is the organization among the plans of the various organisms, among different *Umwelten*. When we analysed the development of organisms, we saw that each cell is an autonomous entity, with its own plan and rule. "In all

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[275] Jedes variierende Individuum ist entsprechend seinem veränderten *Bauplan* anders, aber gleich vollkommen seiner Umgebung angepaßt. Denn der *Bauplan* schafft in weiten Grenzen selbsttätig die Umwelt des Tieres. Diese Erkenntnis, die ich Schritt für Schritt zu beweisen gedenke, kann allein als dauernde Grundlage der Biologie angesehen werden. Nur durch sie gewinnen wir das richtige Verständnis dafür, wie die Lebewesen das Chaos der anorganischen Welt ordnen und beherrschen. Jedes Tier an einer anderen Stelle und in anderer Weise. Aus der unübersehbaren Mannigfaltigkeit der anorganischen Welt sucht sich jedes Tier gerade das aus, was zu ihm paßt, d. h. es schafft sich seine Bedürfnisse selbst entsprechend seiner eigenen Bauart.

[276] Ein jedes Lebewesen ist, solange es seine sämtlichen mechanischen und chemischen Eigenschaften besitzt, in seine Umwelt mit vollkommener Planmäßigkeit eingefügt.

cells, the activities are linked to a common function by a rule (*Regel*). This rule transforms the cell into an independent centre that leads an independent existence. Every cell has its own law (*Eigengesetzlichkeit*); it is therefore an autonomous entity (*Autonom*), because its own law (*Eigengesetzlichkeit*) is part and parcel of the nature of autonomy."[277] (von Uexküll 1928, p. 168). However, different cells are organized into developing buds, which grow together according to the same plan. "(…) each individual cell does not create its own special impulse directing it to a predestined place, but (…) all the cells within a germinal area are directed in common, behaving like iron-fillings under the influence of a magnet." (von Uexküll 1926, p. 213). Here we have the first evidence of the connection between different plans, on different levels, in accordance with a higher plan. In this case, the autonomous cells are always in conformity with the plan of the bud. If we continue looking at a developing organism, we see that the different buds interact to give rise to the organs of the developing embryo. "Each bud works according to its own plan, and since this plan itself actively intervenes to regulate the cell division in such a way that the organ form [appears] from the disordered cell group (…)"[278] (von Uexküll 1929, p. 41).

On the next level, we also saw that each developing group of cells is organized into a whole, giving rise to a whole embryo. "The process by which the subject is progressively differentiated from cell-quality, through the melody of an organ to the symphony of organism, stands in direct contrast to all mechanical processes, which consist of the action of one object upon another." (von Uexküll 2010, p. 8). Here the function of an organism determines the conformity of its development. This means that it also controls the individual plans of the cells downwards from this level. "Now Roux, the pioneering founder of the experimental theory of development, has shown that the goal (namely, the finished, functional framework) is safer than the route followed (i.e. the normal course of its development). From this one may conclude that the rule of function has an influence on the rule of genesis which has not yet been researched"[279] (von Uexküll, 1928 p. 190).

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[277] In allen Zellen sind die Tätigkeiten durch eine Regel zu einer gemeinsamen Funktion verbunden. Diese Regel verwandelt die Zelle in ein selbständiges Zentrum, das eine selbständige Existenz führt. Jede Zelle besitzt ihre Eigengesetzlichkeit, sie ist daher ein Autonom, denn die Eigengesetzlichkeit gehört zum Wesen des Autonomes.

[278] Jeder Spross arbeitet nach seinem eigenen Plan, und da dieser Plan selbst aktiv eingreift, um die Zellteilung so zu regeln, dass die Organgestalt aus der ungeordneten Zellgruppe hervorgeht (...)

[279] Nun hat Roux, der bahnbrechende Begründer der experimentellen Entwicklungslehre, gezeigt, daß das Ziel (nämlich das fertige, funktionsfähige Gefüge) sicherer ist als der Weg (d. h. der normale Ablauf der Entstehung). Daraus darf man auf einen bisher nicht erforschten Einfluß der Funktionsregel auf die Entstehungsregel schließen.

However, the influence of the higher plan on the lower ones goes beyond the body of an organism and extends towards its *Umwelt*. We have already seen this in the fittingness between a subject and its *Umwelt*. In the body of an organism all of its parts are in conformity with the *Bauplan* and this is spatially represented in the framework (*Gefüge*) of the organism. But the framework does not extend outside of the body. All of the elements of the *Umwelt* that are external to the body of organisms are inter-connected through a temporary, non-spatial framework (*Fügung*), produced as the *Bauplan* extends towards the objects in the *Umwelt*. Here we have the functional circle, which is completely in conformity with plan. But this is not all. Organisms do not live in isolation. They interact with other organisms. For example, they also interact with organisms of the same species, with the same *Bauplan*. According to von Uexküll., when they relate to organisms of the same species that live together with them, they are regulated by a "community rule".

In addition, all these interactions happen according to a plan not only higher than the individual but indeed higher than the community plan. In other words, there is also a plan ruling all the individuals of a same species: "This simple instance suggests to us that the diversity of individuals within a species cannot be referred merely to a whim of chance, but may be conditioned by a higher plan. If we could build up together the function-circles of all individuals of one species, we should get the common surrounding-world of the whole species, and, in correspondence with the deviations of the individuals, this would be larger and fuller than that of any of them." (von Uexküll 1926, p. 241).

Ultimately, all these rules govern the life of each organism: "So when it is finished, each individual is a product of three rules: the species rule, the community rule and the individual functional rule (*Funktionsregel*). All three rules must therefore have co-determined the rule of origin that imposed their order on the impulses."[280] (von Uexküll 1928, p. 190). "It is impossible not to recognize here that three rules interlock in conformity with plan"[281] (von Uexküll 1928, p. 194). Furthermore, even between different species there is some interaction, giving rise to a connected whole, as mentioned by Buchanan: "The biological world of animals and their environments consists of an artful play of interconnections, to the degree that one organism is

[280] So ist jedes Einzelwesen, wenn es fertig dasteht, ein Produkt dreier Regeln: der Artregel, der Staatsregel und der individuellen Funktionsregel. Alle drei Regeln müssen daher mitbestimmend auf die Entstehungsregel gewesen sein, die den Impulsen ihre Ordnung auferlegte.
[281] Unverkennbar ist hier ein planmäßiges Ineinandergreifen dreier Regeln festzustellen.

necessary for understanding another. The *Umwelten* of organisms are therefore not simply closed spheres, as if locking the organism within a self-concealed and isolated container (…). Individual *Umwelten* are necessarily enmeshed with one another through a variety of relationships that create a harmonious whole." (Buchanan 2008, p. 28).

Here we can recall the investigative strategy developed by von Uexküll (section 5.A.3). He observed that we cannot fully know the world of other organisms, given that we are restricted by our subjectivity. Thus, he developed a comparative method: finding the connection between common denominators and the specific alphabet of each organism, in order to produce a shared scheme. With this investigation he was able to produce the meta-alphabet – the underlying alphabet of all specific alphabets.

Together with the connectedness between the different rules, we are pointed towards a higher unity in the lives of organisms: "These mutual restrictions provide us with the proof that there is a large-scale interweaving (*großzügige Verschränkung*) that can only be understood from a higher point of view than that offered by the individual, community or species. We can no longer attribute this all-encompassing interweaving to any special formative impulse (*Bildungstrieb*). Here at last we see the action of life as such, working in conformity with plan."[282] (von Uexküll 1928 p. 193). We identified this overarching and encircling unity as the kaleidoscope of nature. All of the different organism-*Umwelten* are tied to each other according to a higher plan than their specific *Bauplan*: "As the living cells constitute the elementary building-stones of all living beings which, composed according to certain construction plans, give rise to the subject capable of constructing an *Umwelt*, the *Umwelten* constitute the building-stones of the next higher order which, in accordance with suprasubjective construction plans build the edifice of living nature" (Uexküll 1980: 378; in Luure 2001). In short: "Uexküll sees the hierarchy of living nature in both directions: down to individual cells, and up from organisms to species and finally to nature as a whole." (Sharov 2001, p. 216).

Ultimately, the interweaving of the different plans provides the decisive evidence against purposiveness in the life of organisms: "It should therefore be our first concern to extinguish

[282] Diese gegenseitigen Beschränkungen liefern uns den Beweis, daß hier eine großzügige Verschränkung vorliegt, die erst von einem höheren Standpunkt, als ihn uns Individuum, Staat oder Art bieten, verstanden werden kann. Diese alles umfassende Verschränkung können wir auf keinen speziellen Bildungstrieb mehr zurückführen. Hier endlich sehen wir die planmäßige Wirkung des Lebens als solche.

the will-o'-the-wisp of the goal in our observation of surrounding worlds. This can only happen inasmuch as we consider the vital expressions of animals from the point of view of the plan. Perhaps certain acts of the highest mammals will turn out to be goal-oriented actions which themselves are part of the overall plan of Nature. With all other mammals, actions directed at a goal are not at all evident."[283] (von Uexküll 1956, p.60).

10.C – Supra-subjective Nature

What kind of world is this? Crucially, it is not a chaotic world, composed of independent and dissociated subjective worlds. It is one organized according to the plan that encompasses all living things. "Without plans, i.e., without Nature's all-controlling conditions of order, there would be no orderly Nature, only chaos."[284] (von Uexküll 1956, p. 66). We do not find chaos and chance, but conformity with plan. "All plans are part of an overwhelmingly great conformity with plan, which has been firmly denied so far."[285] (von Uexküll 1928, p. 233). "These innumerable firmaments have no physical influence on one another. The law that forms and binds them is not physical, but biological, constructed on the activity of the impulse-system arranged in accordance with plan" (von Uexküll 1926 p. 336).

The progressive connectedness of all the different levels of plans leads to the super-subjective plan of Nature, that goes beyond all subjective *Umwelten*. "As we have seen, and as everyone really knows, there is only one objective world, and, on the contrary, hundreds of thousands of subjective worlds. That is why the delusional view has crept in [that sees things] as if the objective world meant a higher reality than the subjective worlds; as if there were only a world of effects (*Wirkungswelt*) and the perceptual worlds (*Merkwelten*) were pure appearance."[286]

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[283] Es muß daher unsere erste Sorge sein, das Irrlicht des Zieles bei der Betrachtung der Umwelten auszulöschen. Das kann nur dadurch geschehen, daß wir die Lebensäußerungen der Tiere unter dem Gesichtspunkte des Planes ordnen. Vielleicht erweisen sich später gewisse Handlungen der höchsten Säugetiere als Zielhandlungen, die selbst wieder dem gesamten Naturplan eingeordnet sind. Bei allen anderen Tieren kommen auf ein Ziel gerichtete Handlungen überhaupt nicht vor.

[284] Ohne Pläne, d. h. ohne die alles beherrschenden Ordnungsbedingungen der Natur gäbe es keine geordnete Natur, sondern nur ein Chaos

[285] Alle Pläne gehören einer überwältigend großen Planmäßigkeit an, die man bisher abzuleugnen bestrebt war.

[286] Es gibt, wie wir sahen, und wie eigentlich jedermann weiß, nur eine objektive, dagegen Hunderttausende von subjektiven Welten. Darum hat sich auch der Wahn eingeschlichen, als bedeute die objektive Welt eine höhere Realität als die subjektiven Welten, als gäbe es nur eine Wirkungswelt und als wären die Merkwelten nur Schein.

(von Uexküll 1913a, p. 201). We can thus describe Nature: "The universe consists of subjects with their surrounding worlds (*Umwelten*), which are connected by functional circles into a planned whole. This is where the real natural factors (*Naturfaktoren*) that make up the future task of biology lie. The universe still lies before us as an unravelled, often shivering splendour of thousands of overlapping gardens, each of which bears its [own] flowers and its [own] trees,"[287] (von Uexküll 1928, p. 231).

As we saw at the end of chapter 5, the detection of a meta-alphabet allows us to solve the anthropocentric temptation, the danger of pervasive subjectivity. Brentari deals with this topic in the following terms: "In Uexküll's concept, turning to nature as a macro-subject would reduce the contradictiveness of environments to a perspective effect: the contradictiveness of the scientific sphere and the cognitive sphere in general would indeed continue to depend on different (and all equally legitimate) environmental interpretations provided by various subjects, but would disappear if the entirety of environments were considered as the product (unfortunately inaccessible to our mind) of a single original subject, nature." (Brentari 2015, p. 156). And Hoffmeyer goes pretty much in the same direction: "We can summarize the discussion so far by noting that the *Umwelt*s [sic] of animals certainly have developed in accordance to a plan of nature, a plan that all the time traps life in certain strategic choices and at the same time diversifies the dimensionality of ways to deal with these choices" (Hoffmeyer 2004, p. 14).

In summary, we have seen how the conformity with plan, the natural factor, interacts with organisms through the intermediate factors (impulses and steersmen). We have also just seen how we have evidence of the existence of this natural factor. Yet, the question still remains: can we know the complete plan of nature and thus the natural factor? Once again, according to von Uexküll, the answer is *no*. It is inaccessible to us. "The role Nature plays as an object in the various environments of natural scientists is highly contradictory. If one wanted to sum up its objective characteristics, only chaos would result. And yet, all these different environments are fostered and borne along by the One that is inaccessible to all environments forever. Forever

[287] Das Universum besteht aus Subjekten mit ihren Umwelten, die durch Funktionskreise zu einem planvollen Ganzen verbunden sind. Hier liegen die wirklichen Naturfaktoren, die aufzusuchen die Zukunftsaufgabe der Biologie bildet. Noch liegt das Universum vor uns als eine unentwirrte vielfach schillernde Pracht von abertausend sich überschneidenden Gärten, von denen ein jeder seine Blüten und seine Bäume trägt,

unknowable behind all of the worlds it produces, the subject—Nature—conceals itself."[288] (von Uexküll 1956, p. 101). What about Driesch?

[288] Es ist die Rolle, die die Natur als Objekt in den verschiedenen Umwelten der Naturforscher spielt, höchst widerspruchsvoll. Wenn man ihre objektiven Eigenschaften zusammenfassen wollte, so ergäbe sich ein Chaos. Und doch werden alle diese verschiedenen Umwelten gehegt und getragen von dem Einen, das allen Umwelten für ewig verschlossen bleibt. Hinter all seinen von ihm erzeugten Welten verbirgt sich ewig unverkennbar das Subjekt — Natur.

Chapter 11 – Driesch: Grasping the Absolute

Returning to Driesch's ideas, we are trying to understand the relationship between Entelechy and the natural factor directing its action. We saw that, according to Driesch, we cannot know the origin of the action of Entelechy, and we know nothing about the way entelechy "wills and knows" it. We then jumped back to von Uexküll's ideas and saw that his biological theory points to a unity beyond the subjective reality of an organism. However, we concluded that we cannot know this Nature.

Do we find a similar answer in Driesch? Why can we not know the origin of Entelechy? What does it correspond to?

11.A – Phenomenal World

As we reach the endpoint of Driesch's ideas it is crucial to adequately contextualize his biological ideas in a broader sense.

Driesch is always concerned with the elements that we actually perceive (what he calls the *Given*). *Givenness* concerns the existence of an immediate object: "For practical purposes I almost always know when I have to refer to an immediate object, a 'givenness' so to say (…)" (Driesch 1914a, p. 190). In other words: "Our *acquaintance* with the objects of Nature – to begin with this topic – *always* starts from sense-data which possess a spatial character, let me say: *a sign of spatiality*. Data relating to Nature are always not only *now* and *such*, but also *here*. All that we *immediately* know about Nature is, then, of the form of a *now-here-such*." (Driesch 1914b, p. 46-47)

In this way, the elements that we have been using so far in Driesch's biological theory are understood as part of our own perspective of events: "Our whole argument has rested so far upon pure idealistic phenomenalism; we have analysed the Given so far as it certainly is my phenomenon. In this sense, forces and entelechies were agents in nature as part of my Givenness; they were concepts auxiliary to the understanding of Givenness." (Driesch 1908, vol. 2, p. 359).

We usually understand this statement to mean that when we detect some element, we are capturing (even if partially) something that exists on its own. Something "out there" that we are perceiving. However, Driesch does not actually affirm this. That is, Givenness, what we access in Nature, does claim to have an "absolute" view of Nature. It corresponds to our own view. "When I say that a thing *is*, it always and exclusively means that it is or may be an object for my consciousness. This applies also to *natural* objects, for we have said nothing whatever about Nature, except that its objects may be regarded *as if* they had an independent existence of their own." (Driesch 1914b, p. 75). Driesch's claims therefore rest on a solipsistic basis: "(…) it is *my* Nature and only behaves *as if* it were independent in itself." (Driesch 1914b, p. 77).

This means that the spatial elements that we, the observer, detect should not be expected to produce a full picture of Nature. "It is no longer necessary to look upon spatial data as a strange image of the Absolute in its completeness and then to be disappointed with this strange image. There is *not* a complete 'image' of the Absolute in space. This is one of the metaphysical consequences of vitalism which we wished to mention." (Driesch 1914b, p. 78).

At a first glance, Driesch's solipsist claim appears to be very much like the subjective nature of reality stated by von Uexküll. However, it is crucial to separate the two. This is an important disclaimer since it helps contextualise Driesch's next affirmations, and it also highlights the particularity of von Uexküll's theory.

Unlike von Uexküll, Driesch's solipsism, or phenomenalism, is only a methodological instrument and not a definite statement. "Solipsism, then, is *not* dogmatic, not even in a negative manner. It does *not* say: What I consciously have is *nothing but* my phenomenon. It merely says: What I consciously have is *certainly* my phenomenon – whether it 'be' anything else or not." (Driesch 1914b, p. 76). He adds: "We may speak here of solipsism as a critical method or of *methodological* solipsism; and this methodological solipsism is the true critical philosophy, i.e. the one philosophy that tries to stand on firm ground and not to say anything from a dogmatic point of view that can be said non-dogmatically." (Driesch 1914a, p. 233)

With this claim, Driesch is trying to find a starting point for his analysis of Nature. All that we know is that, *at least*, what we detect is part of our world: "For I have *not* said: 'the world of my objects, both immediate and mediate or natural, is only my world'. But I have said: 'it is *my* world *in any case*,' or, in other words: 'this I know: it is *my* world.'" (Driesch 1914a, p. 233). In other words, whatever is there beyond our spatial data, this is where we start from:

"This does not mean that all the immediate objects of our consciousness which are of the form of a now-here-such signify mediate objects of Nature. We have already said that they do not. It means that there are *no* states of Nature knowable to us immediately, *except* by data of this form." (Driesch 1914b, p. 46-47).

He summarizes: "Now, the 'Given' as conceived in space of three dimensions, as regarded to 'exist' even when it is not directly perceived, as subjected to causality in its different forms, may well be called 'phenomenological' so far as it is not regarded as something absolute, i.e. metaphysically, and science is possible without regarding the Given in this way." (Driesch 1908, vol. 2, p. 201-202). And: "*Our* 'phenomenalism' is identical with critical non-metaphysical idealism; in this form it is the only basis of science that is quite free from prepossessions of any kind, and therefore all science should *start* from this idealism, even if metaphysics is to form its *end*." (Driesch 1908, vol. 2, p. 202).

Obviously, the question of *what exactly is there* remains. But this involves "evading" the limitations of phenomenalism and solipsism. "Is there really no way to escape from phenomenalism to something absolute, to 'metaphysics', that is to say, to something that is *not exclusively* 'my phenomenon'? And what does all our argument amount to on a metaphysical basis?" (Driesch 1908 Vol. 2, p. 359). According to Driesch this can be done through a metaphysical claim or some other kind of statement about the Absolute. "Solipsism is by no means satisfactory; there is something in it that appears as a gap. Or, in other words: for mere reasons of order the solipsistic theory of order must try to come out of itself, to become something other than it was, namely, *metaphysics*, or a system of hypothetical statements about something that is *not merely mine*; though, of course, it must have the faculty to also become mine, otherwise I should not be able to deal with it at all." (Driesch 1914a, p. 233-234).

However, similarly to von Uexküll, Driesch finds it impossible to move out of our solipsistic view and face the Absolute: "It is meaningless to raise the question, whether any feature of natural reality in its empirical suchness or quality be 'the same' as the suchness of a feature of absolute reality taken 'in itself,' or whether it be only an 'image' of the absolute suchness. For in order to decide this question we should have to compare a something 'for myself' with a something only in so far as it is 'in itself'; and this is impossible, because the 'in itself' must become 'for myself' in order to be known at all." (Driesch 1914a, p. 235). In his view, even metaphysics must therefore always be hypothetical and not dogmatic. "Never, of course, can metaphysics become a system of statements that possess absolute certainty:

metaphysics always *must* be hypothetical in the strict sense of the word." (Driesch 1914a, p. 234). "In other words: metaphysics must use the method of induction in the deeper sense of the word, and can only reach *hypothetical* results" (Driesch 1914b, p. 76)

The preceding analysis is decisive for contextualising the claims of Driesch's whole biological theory. After stating the limitations of metaphysical claims, we should note that Driesch's ideas are not of this nature. They are only concerned with what is detected in the world of an observer, and nothing more: "Now the theory of order deals merely with what *I* consciously possess, and is therefore *absolutely free from metaphysics"* (Driesch 1914b, p. 75).

11.B – Windows to the Absolute

After considering these introductory remarks, we find a difficulty that was already tackled in von Uexküll's biological theory: if we are restricted to our phenomenal experience, how can we have any hint about the existence of an Absolute, of Nature? As we saw, according to Driesch, even though we cannot prove it, we might glimpse it: "(…) from a room with windows of ground-glass we may perceive the 'fact' that there is something outside without knowing in any way what it is." (Driesch 1908 Vol. 2, p. 360). The path to move out of our phenomenal experience, is, according to Driesch, to detect elements that exist beyond its spatial framework. As we just quoted: "There is *not* a complete 'image' of the Absolute in space" (Driesch 1914b, p. 78).

Already in the previous section we found evidence of a new category that goes beyond those of substance and causality. This was the category of Individuality, manifested in the action of Entelechy.

We saw above that Entelechy is a non-spatial agent. It does not have an extensive nature, and it does not depend on any kind of substance. It is an intensive manifoldness. But while it is not in space, nevertheless it acts: "Entelechy is an agent *sui generis*, non-material and non-spatial, but acting 'into' space, so to speak (…)" (Driesch 1914a, p. 204). We saw above how this conclusion was reached through Driesch's experiments. "In our vitalistic theory we have shown that in a field of research, which may be said to be artificially limited, there is reason to

assume that non-mechanical natural agents are at work, acting not in space but 'into' space, so to say." (Driesch 1914b, p. 73)

Consequently, we are only able to detect Entelechy as it acts, as it manifests itself in space. We have seen how this action is observed as "individualizing causality", which gives rise to whole individuals, producing a unity from the arrangement of the different parts of the system: "Now we have seen that what we have called singular causality fully appears to us in space, but that unifying or individualising causality, as one of the three other forms of possible becoming in nature, has only, so to say, points of effect in space, but is *not* in space *as* becoming. Quite apart from time, then, there is certainly *one* special system of relations in the absolute, *besides* the one that corresponds to experienced spatiality; and we only know about this system in so far as it cuts, so to speak, across the system which we know under the sign of spatiality." (Driesch 1914a, p. 236).

Ultimately this means that, although we may not have a direct access to this Absolute, we can detect it as it manifests itself "into" space through the action of Entelechy, through individualizing causality: "(…) absoluteness must be such as to be able to become part of our phenomenological Givenness under the form not only of causality, substance, and inheritance, but also of individuality (…)" (Driesch Vol.2, p. 369-370). We now find we have in space the evidence of an agent and a category that are beyond the spatial framework, thus pointing to something beyond it. "There is more in Nature than merely something in space; there is something in it that only has certain discrete points of manifestation in space, so that space data can give us only fragments with regard to Nature as it is." (Driesch 1914b, p. 77)

Now we can ask the next question: "But what will happen if now we allow *Nature* to be a sign of something that is more than Nature as a concept of order, i.e. of something absolute?" (Driesch 1914b, p. 77)

11.C – Supra-Personal Entelechy

We saw that Entelechy is not spatial, not an extensive manifoldness. This conclusion was reached when Driesch observed that a spatial Entelechy does not explain the results found in his experiments. As Smith puts it: "To say that there is such a thing as a material, chemical, living substance that 'bears' entelechy would be to attribute extensity to entelechy, for the one

characteristic of material substance is extension. That entelechy is extended is impossible; otherwise the divisions performed in the embryo of the sea-urchin would have given very different results than they did." (Smith 1955, p. 205).

Consequently, if Entelechy is not spatial, is it divisible? As we mentioned above, the defining characteristic of a living being is its totality, its wholeness; an organism is not just a sum of its parts. What should we therefore expect: do we have many different Entelechies accompanying the ongoing processes of division, or just one Entelechy, manifested in different forms? According to Smith: "The fact that a complete organism was evolved shows that the entelechy must itself have been left whole and undivided by the division" (Smith 1955, p. 205). He adds: "It can be only the material organism that is divided, the entelechy itself is not. Here is the first bit of evidence to solve the problem of individuality of the entelechy. There are not as many entelechies as organisms. (Smith 1955, p. 208). In Driesch's words: "(…) entelechy may manifest itself wholly even after the division of a certain organic body, on which, had it remained one whole, entelechy would have manifested itself as *one* whole also." (Driesch 1908 Vol.2, p. 258).

We thus reach a decisive point. There is a unity in all the manifestations of Entelechy. It is not restricted to individual organisms. Driesch labels it by saying that Entelechy itself is supra-personal. "In this sense entelechy, though individualising, is supra-individual itself, as E. von Hartmann pointed out most clearly, or may rather be said to be 'supra-personal'". (Driesch 1908 Vol.2, p. 317). In Smith's words: "(…) looking at the problem from the aspect of the many organisms produced by one, we are faced with the metaphysical absurdity of supposing that non-spatial entities can be divided or even fused." (Smith 1955, p. 208-209).

To Driesch, the conclusions from these indications seems to be the existence of one super-personal entelechy, which, however, exists in two different states. As Smith puts it: 'in the one-modus and the many-modus'." (Smith 1955, p. 208-209). In other words, while there may be different manifestations of Entelechy, they all derive from a primordial one: "In fact, we may speak of an order concerning the rank or dignity of entelechies, comparable with the order of ranks or dignities in an army or administration. But all entelechies have originated from the primordial one [of the egg], and in this respect may be said to be one altogether." (Driesch 1908 Vol.2, p. 150).

11.D – Harmony in Nature

Do we find any signs of this supra-personal unity around us?

One of the examples that Driesch provides is looking at the organization of the natural world. According to Driesch, there appears to be, in both the organic and inorganic world, some evidence of a general harmony: "(…) there seems to me to be a certain sound foundation in the concept of the general harmony between organic and inorganic nature, a something which seems to show that *nature is nature for a certain purpose*." (Driesch 1908 Vol.2, p. 349). In his view, this harmony played an important role in the ideas of the 18th century where "the different types of organisms were considered as being in mutual teleological correspondence, animals indeed in their present state being certainly unable to exist without plants." (Driesch 1908 Vol.2, p. 348).

What does he mean by "harmony"? Crucially, we are always talking about a statical type of teleology: "Of course, any such harmony would be merely statical in the first place, i.e. a given teleological arrangement and no more. But it would be much if even that could be proved." (Driesch 1908 Vol.2, p. 349). Is it possible to demonstrate the existence of such a harmony in the natural world?

Inside this question Driesch identifies two separate issues. First, the putative existence of harmony in nature may be due to the existence of a true Individuality in the arrangement of the inorganic world. That is, what is at stake is the concept of the inorganic world itself as a whole. Driesch, however, says that we cannot reach a conclusion through this path: "Of an immanent or entelechian teleology we most decidedly know absolutely nothing in this domain of nature; were it otherwise, our task would not be difficult. (Driesch 1908 Vol.2, p. 350). In other words: "(…) *nothing is quite certainly* known, either about a harmony or a truly teleological and individual constellation either in the general distribution of kinds of matter or in planetary or sidereal arrangements." (Driesch 1908 Vol.2, p. 351-352).

What is the alternative? Driesch attempts to put the possible harmony of the natural world in conformity to organisms, "anthropomorphizing" it: "(…) the only thing we can do teleologically is to search for *some* point among inorganic specificities of constellation, which might possibly relate to *some* imaginable purpose. And the organisms alone can be such purposes. (Driesch 1908 Vol.2, p. 350). And also: "(…) there are some *approximations* at least to a general statical *harmonious* teleology with regard to living beings and man." (Driesch

1908 Vol.2, p. 352). This means that we can we talk about a statical teleology in the inorganic world, as long as it relates to organisms.

How far does this purposiveness extend? “Granted that there is purposefulness at least of the statical or constellative type in the specific distribution of matter and sidereal masses with regard to the welfare of organisms: how far does this purposefulness go? Does it possibly extend to the most minute singularities?” (Driesch Vol.2, p. 365).

Driesch argues that this is not the case. Along with purposiveness there is also contingency in the world. As Driesch summarizes: “We know that embryological becoming is ‘vitalistic,’ that it is impossible to comprehend it by the laws of physics and chemistry. But does this statement apply to each singleness in the course of embryology? Certainly it does not: the position of the single cells in the different organs of the embryo or the adult is, probably in almost all cases, contingent; and is different in each individual of the same species. Unity and unifying causality apply only to the arrangement of organs in general and to the general features of form—say, of the single bones of vertebrates—but not to any intimate details.” (Driesch 1914a, p. 226). In other words: “There are probably domains of at least past entelechian manifestations in the universe, both inorganic and supra-personally organic. The harmony in nature, statical at present, is their result. But the universe is not in every historical detail a teleological system; at least the human mind is unable to conceive it as a ‘universe’ throughout. There is ‘contingency’ i.e. non-teleology, in the universe, not only apparently but really.” (Driesch Vol.2, p. 366-367)

In the end, as we concluded from the initial statements of this chapter, , we cannot have a total inorganic organization. All the purposiveness in the inorganic world is eventually related to the purposiveness of organisms: “In other words, real teleological constellations in the Inorganic if discoverable at all would only relate to a mutual harmony among different classes of events with special reference to organic life in general, but would not apply to this particular event at this particular time and place.” (Driesch Vol.2, p. 366-367). If all inorganic events were purposive: “Then the whole universe would be one teleological unity in every detail. No: then only would it be ‘one universe’ throughout. Only then would there be no ‘contingency’ whatever.” (Driesch Vol.2, p. 365).

Only in this sense can we talk about a harmony in nature: “(…) we have at least a *hypothetical* right to speak of certain constellations in givenness, other than organisms, which

are teleological in the sense of a statical *harmony of nature*. It is true, this harmony is statical, it is a teleology of constellation, of being, not a teleology *in* becoming as the teleology in organisms is." (Driesch Vol.2, p. 369-370). Or, as he also puts it: "(…) there are some inklings of a supra-personal harmony, at least from an anthropomorphic point of view, some inklings of a general sort of statical harmony in the whole of nature, as the old naturalists asserted." (Driesch Vol.2, p. 353).

11.E – Primary Entelechy

The above has identified that harmony in nature can be explained in a statical teleological manner. Yet, this stage should already be familiar to someone who has followed Driesch's intellectual journey sketched in Chapters 2 and 3.

We concluded Chapter 3 with the introduction of Entelechy as the dynamical factor, overriding the machine-theory of life as the most plausible explanation for the morphogenesis of organisms. The final blow is dealt by Driesch when he states: "(…) whenever we find typical constellations of the statical-teleological class, we are forced to conclude that there must have been in some former time some autonomous intrinsic activity." (Driesch 1908 Vol. 2, p. 342). This "activity" is provided by Entelechy: "entelechy has created this basis, and so statical teleology has its source in dynamical teleology." (Driesch 1908 Vol. 2, p. 151). Can we extend the same argument to the statical teleological arrangement of nature? Driesch himself hints at this step: "One state of this statical teleology leads back to an earlier state, which again leads back, and so on, one of these states following from the other mechanically." (Driesch Vol.2, p. 369-370)

In fact, if we refer to what we have just introduced above, it is easy to take the argument for the existence of a supra-personal Entelechy and extend it. Supra-personal entelechy can explain the existence of a harmony in all nature. As Smith states: "The impossibility of dividing the entelechy when the organism reproduces, and the obvious fact of unity in the universe lead Driesch to an assertion of a sort of world-entelechy – a super-personal source of unity in the universe." (Smith 1955, p. 221). Should not the "universal" statical teleology, or harmony, therefore be explained by a "universal" dynamical agent, or Primary Entelechy (as Driesch calls it)? "But does not this hypothetic statical harmony among certain domains of nature point back

to an original primary entelechy that made it just as the artist makes an object of art?" (Driesch 1908, Vol.2, p. 370).

Such an agent would provide the explanation for the harmony and unity in nature, and, according to Driesch, would reconcile the purposeful and contingent characteristics of the world: "This *primary entelechy* would not have created absolute reality, but would have *ordered* certain parts of it, and these parts therefore would show a sort of non-contingent constellation whilst all other constellations of the elementalities of the universe would be contingent. (Driesch Vol.2, p. 370)

Driesch summarizes this worldview as follows: "There is the material world as the world of chance, but there is also a world of form or order that manifests itself in certain areas of the material world, namely in the biological individual, and probably, in another way, in phylogeny and history also; there *may* even be form-like constellations in what we call the Inorganic." (Driesch 1914b, p. 74-75).

11.F – Conclusion: Grasping the Absolute

The objective of this section was to find ways in which Driesch is able to glimpse the existence of the Absolute in his biological theory. We saw that the existence of harmony in nature, coupled with the unicity of supra-personal Entelechy, allowed Driesch to postulate the existence of a primary Entelechy. This universal dynamical agent would be the basis for all of the statical teleology in nature.

What does this tell us about the Absolute? Can we actually know it? "What does that mean with regard to the Absolute, now that we know that objectified Givenness tends to show us something about the Absolute?" (Driesch 1908 Vol. 2, p. 369). Ultimately, the answer is the same as before: The Absolute is beyond our reach.

What have we learned in the end?

We saw that primary Entelechy has the same characteristics as all entelechian manifestations that we have described: it is not spatial, and we only have some perception of Entelechy as it acts "into" space. In this way, agents like Entelechy are, as it were, a "sample" of the Absolute: "(…) 'natural agents' with regard to single events in Givenness, say the fall of a particular stone

or the morphogenesis of a particular animal, would now appear as what might be called a sort of *emanation* from the Absolute, as a something that has its source in the Absolute. With regard to causal force and biological entelechy such an emanation may actually happen before our eyes, as it does in inorganic events and in living organisms. But it also may *have happened*, if our hypothesis of an individualised general harmony in nature is justified." (Driesch Vol.2, p. 373).

However, we cannot prove that all the elements of the Absolute can have a spatial manifestation like Entelechy: "Be the Absolute what it may, in any case it cannot be postulated to assume that all its elementary characters are able to be symbolized to the human mind by spatial signs." (Driesch 1914b, p. 72-73).

In fact, on the one hand, there may be other elements of the Absolute that have no kind of spatial manifestation: "And who can say how many kinds of being or becoming there may be in reality which are absolutely inaccessible to us, because they are not marked by spatial signs at all?" (Driesch 1914a, p. 226). And on the other hand, at the end of the day, these spatial manifestations are insufficient. We do not completely know even Entelechy, which we can perceive in its action, since it is ultimately a non-spatial element: "All that is imaginable must have spatial characteristics, and it is quite impossible to form an imaginable idea of something that is manifold but not in space." (Driesch 1908 Vol.2 p. 320). Ultimately, Entelechy in its different forms cannot be conceived outside of our subjective experience: "Thus entelechies, though transcending the realm of the Imaginable, do *not by reason of their logical character as such* form constituents of metaphysics in the sense of something absolute and independent of a subject" (Driesch 1908 Vol.2, p. 320).

Overall, these observations extend what Driesch introduced as the solipsistic or phenomenal view: we only have some degree of certainty over what is spatially revealed in our world. But now we accept that there may be elements of the Absolute that never manifest themselves spatially, and this hinders our ability to know the Absolute: "For if we allow the Absolute to consist of innumerable qualities which are *not* spatially symbolized and are therefore unknowable, it follows that the world of experience proper can only give us a fragmental knowledge of absolute Reality and nothing more. We do not speak here of temporary ignorance due, say, to the minuteness or remoteness of the objects, *but of the fundamental impossibility of knowing*. In short, because we are human, i.e. spatially limited beings, we *cannot* know." (Driesch 1914b, p. 73)

In conclusion, the Absolute is something that we can only glimpse into, but never fully know: “For it only is through ground-glass windows, as it were, that we are allowed to look into absoluteness; we only know the ‘fact’ of the Absolute absolutely; whilst bound to our categorical system, we only know quite vaguely the ‘how’ of the Absolute.” (Driesch Vol.2, p. 371).

Ultimately, it appears that we have hit a dead end. We cannot know beyond our phenomenal experience. What exactly is “out” there? According to Driesch, not even metaphysics can produce a definite claim. It is ultimately a matter of belief: “The problem is, then, accurately formulated; but now we see at once that we cannot solve it; and this for the very reason which prevents all metaphysics from going beyond probabilities or even mere possibilities.” (Driesch 1914a, 238).

But, according to Driesch, this is not the objective of the vitalistic enterprise. The definite conclusion is that life is more than just the sum of inorganic parts, it is an Individuality, wholeness, totality or unity. “But what is not a mere belief and not a matter of feeling is the existence of factual wholeness in Nature, the existence of something that is certainly more than a mere sum. And to have proved this, and thus to have given a sound foundation to all further speculations about natural and metaphysical *wholeness*, is the merit of vitalism.” (Driesch 1914b, p. 81).

Chapter 12 – Conclusion

Where is this whole analysis leading us to? Can we finally produce a verdict on Jacob von Uexküll's biological theory? In order to do this, we need to take a step back and look again into von Uexküll's views as a whole. What kind of knowledge claims is he putting forward here?

In part 2 of this work it became clear that we are trying to find the natural factor: the factor behind the super-mechanical properties of life. According to von Uexküll, we should find it in the overall plan of nature. Yet, several questions appear: What is this natural factor? How can we say if such an organizing factor exists or not? Do we have any evidence of a plan above our subjective *Bauplan*?

Any possibility of answering these questions appears to be compromised, since we do not have any insight into the plan of nature, nor do we have complete knowledge of the *Bauplan* of any other organism. We are always restricted to our subjectivity. As we saw, this means two things: First, that each subject is enclosed in its own *Umwelt*, and secondly, that the world of each organism is inaccessible to other subjects. Cassirer calls our attention to this point: "As he [von Uexküll] points out, it would be a very naive sort of dogmatism to assume that there is an absolute reality of things which is the same for all living beings. Reality is not a unique and homogeneous thing; it is immensely diversified, having as many different schemes and patterns as there are different organisms. Every organism is, so to speak, a monadic being. It has a world of its own because it has an experience of its own. The phenomena that we find in the life of a certain biological species are not transferable to any other species. The experiences—and therefore the realities— of two different organisms are incommensurable with one another." (Cassirer 1944, p. 23)

However, as we have seen in chapter 10, the conformity with plan of the different organisms points to a unity higher than an organism itself. The regression from plan to plan (starting from the plan of a single cell towards the plan governing the totality of organisms) points to a higher unity among all living things. As mentioned before, von Uexküll calls this unity nature. "This means we are on track of a control by Nature pointing to a unity even higher than our own apperceptions, in which otherwise we must see the final unity" (von Uexküll

1926, p. 86). Consequently, while at the same time defending the abolishment of an absolute world, he is arguing for the existence of a supra-subjective factor.

"'Whoa there!' I can hear the mechanicists shout. 'The theory of environments is showing its true face here as metaphysics. For anybody who looks for effective factors beyond the physical world is a metaphysician."[289] (von Uexküll 1956, p. 121). What does this mean for von Uexküll's claims? At the end of Chapter 8 we saw how he points to an overall organizing natural factor. But the evidence in favour of this factor has been questioned by other authors: "(…) the use of the word *Planmässigkeit* ('purposiveness', or in the strict sense of the word: `that everything shall take place according to a plan') has been the reason for the criticism. Apparently, the critics have held the presence of a plan in natural processes as unverifiable." (Jamsa 2001, p. 497). As reported by von Uexküll's wife, "though they had recognized the importance of Uexküll's experiments on muscles and nerves, specialists would not hear about an "immaterial construction plan" – i.e. the key topic in *Theoretische Biologie*. It must have reeked too much of metaphysics!" (von Uexküll 1964, p. 133; in Brentari 2015, p. 33).

What are these metaphysical accusations? The issue is that there is some factor lying outside all subjective experiences. We can also detect this (repetiçao de claim) in one of von Uexküll's most important statements: "*All reality is subjective appearance*. This must constitute the great, fundamental admission even of biology" (von Uexküll 1926, p. XV, his emphasis). Here, von Uexküll is claiming to be outside the subjective point of view he is defending. Pobojewska puts her finger on the problem: "He refers to it as *a collection of `soap bubbles' inaccessible from the outside of the worlds of given subjects*. The vision thus evoked makes us clearly aware of the cognitive hermeticality of each subjective world, including the human world. The declaration that `all reality is a phenomenon of living beings', referring to worlds different from the human one, can thus in no circumstances have a theoretical status, but is a metaphysical option. It is logically primary to the epistemological assumption concerning the phenomenological status of science which indicates one of the conditions of human reality only." (Pobojewska 2001, p. 326).

[289] Halloh! höre ich die Mechanisten rufen: Hier entlarvt sich die Umweltlehre als Metaphysik. Denn wer die wirksamen Faktoren jenseits der körperlichen Welt sucht, ist ein Metaphysiker.

How does von Uexküll respond to these accusations? As we can see, they are based on the scope of the biological investigation. As Pobojewska puts it: "All Uexküll's statements about an all-powerful Nature (…) should be treated as belonging to metaphysics because they go beyond the scope of science." (Pobojewska 2001, p. 332). How does von Uexküll answer this? What is the role of biology?

12.A – The Range of Natural Science

In short, Von Uexküll answers by claiming that the role of biology is not to fully understand the overall plan of nature. In fact, it is intrinsically unable to do so. Why is that?

First of all, we must always remember one of the central aspects of von Uexküll's theory – the subjective nature of the world, which is itself a "total totality". In other words, each species is restricted to its own organism-*Umwelt* unity. Consequently: "It is not possible even for the biologist to transfer the event observed by him (as in the case of an animal influenced by an external object) outside the frame created by his own subjectivity. He is always dealing with events that take place in *his* space and in *his* time and with *his* qualities" (von Uexküll 1926, p. 136). The subject can only detect the phenomena in its world: "This individual is always a subject, because it always forms a new world-centre. Everything that happens, happens for the individual only in so far as the phenomenon becomes a new indication within it. The indications [notes] are, so to speak, the lighthouses of the individual, from which it gets glimpses of the world. Each individual has only so much world as it is subjectively accessible to it." (von Uexküll 1926, p. 354).

Can we still detect some factor encompassing our subjective world? As we discussed in chapter 10, even though biology is restricted to the organism-*Umwelt* unity, we are able to extrapolate the existence of an overlying factor: "[Biology] wants only to point to factors that are present in the subject beyond sensorily given phenomenality and which should serve to clarify the interrelations of the world of the senses."[290] (von Uexküll 1956, p. 121). Eventually we are able to intuit a supra-personal plan, a meta-alphabet: "The most significant progress, however, comes from the following conclusion: If we recognize the law-like regularity

[290] [Biologie] will nur auf Faktoren hinweisen, die diesseits der sinnlich gegebenen Erscheinbarkeit im Subjekt vorhanden sind, und die dazu dienen sollen, die Zusammenhänge der Sinnenwelt deutlich zu machen.

(*Gesetzmässigkeit*) that is found in the forms of our own attention (and which is decisive for the world of appearance of our own subject), not only in the design of our own body, but also in the shaping of the bodies of other subjects, whose forms of attention we know nothing about, this indicates that the shaping of perceptual-signs (*Merkzeichen*) is not just due to our subject, but is over-subjective. And that we are on the way here to tracing a force of nature that indicates a unity above our own apperception, in which we are otherwise able to recognize the last unity."[291] (von Uexküll 1928, p. 70)

By identifying this limitation in the field of biology von Uexküll dismisses the metaphysical accusations thrown at his subjective theory: "Biology lays no claim to such a far-reaching metaphysics. It wants only to point to factors that are present in a subject within the realm of sensorily given phenomenality and which should serve to clarify the interrelations of the world of the senses. But biology has absolutely no wish to turn upside down the world of the senses, as the new physics does." [292] (von Uexküll 1956, p. 121).

Ultimately, according to von Uexküll, the task of biology is to recognize this all-encompassing plan, while remaining limited to our own *Umwelt*: "There are not only the manifoldnesses of space and time in which things can be spread out. There is also the manifoldness of surrounding worlds, in which things repeat themselves in ever new forms. All these countless surrounding worlds provide, in the third manifoldness, the keyboard on which Nature plays her symphony of meaning beyond time and space. In our lifetime, the task is given to us to form with our surrounding world a key in the gigantic keyboard over which an invisible hand glides, playing."[293] (von Uexküll 1956, p. 159).

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[291] Der bedeutsamste Fortschritt aber liegt in folgendem Schluß: Wenn wir die Gesetzmäßigkeit, die sich in den Formen unserer eigenen Aufmerksamkeit vorfinden (und die ausschlaggebend ist für die Erscheinungswelt unseres eigenen Subjekts), nicht nur in der Gestaltung unseres eigenen Körpers wiedererkennen, sondern auch in der Gestaltung des Körpers fremder Subjekte, über deren Aufmerksamkeitsformen wir nichts wissen, so deutet das darauf hin, daß die Formgebung der Merkzeichen nicht bloß durch unser Subjekt bedingt ist, sondern eine übersubjektive ist. Und daß wir hier auf dem Wege sind, einem Naturwalten nachzuspüren, das auf eine Einheit hinweist, die noch über unserer eigenen Apperzeption steht, in der wir sonst die letzte Einheit zu erkennen vermögen.

[292] Eine so weitgehende Metaphysik beansprucht die Biologie gar nicht. Sie will nur auf Faktoren hinweisen, die diesseits der sinnlich gegebenen Erscheinbarkeit im Subjekt vorhanden sind, und die dazu dienen sollen, die Zusammenhänge der Sinnenwelt deutlich zu machen. Sie denkt aber gar nicht daran, die Sinnenwelt auf den Kopf zu stellen, wie die neue Physik es anstrebt.

[293] Es gibt nicht nur die beiden Mannigfaltigkeiten von Raum und Zeit, in denen sich die Dinge ausbreiten können. Es gibt noch die Mannigfaltigkeit der Umwelten, in der sich die Dinge in immer neuen Formen wiederholen. All die zahllosen Umwelten liefern in der dritten Mannigfaltigkeit die Klaviatur, auf der die Natur ihre überzeitliche und üb er räumliche Bedeutungssymphonie spielt. Uns ist während unseres Lebens die Aufgabe zugewiesen, mit

The decisive question is thus: can we ever fully know this "keyboard of nature", the shape of the "meta-alphabet? Can we know the purpose of this "total unity"?

Ultimately, the answer is *no*. As we study the different worlds of organisms, the "kaleidoscope of life" is forever increasing in its complexity. Inside our subjective world there is a countless number of other worlds, corresponding to the unfathomable worlds of other subjects, the Uexküllian "soap-bubbles". While we can find the common denominators between these worlds and our own, they are forever inaccessible to our full comprehension. In this way, Nature includes all of the different subjective worlds – which are "total totalities" in themselves – but it can never be reduced to any of these worlds. In the end, as von Uexküll says: "The newly discovered telescopes seemed to be trying to master the infinity of space, and yet they only pushed back the visible a little further, without ever being able to burst the bonds of the extended. In the same way, microscopes seemed to open up the world of the infinitely small, but they also were able to expand the limits of the visible only a small way. Even between the smallest points the extended always reappeared, enveloping them like a firm wall." (von Uexküll 1926, p. 334)

This means that biological research cannot go beyond each organism's subjective experience. And is therefore unable to know any super-mechanical factor: "Material factors are not enough to explain life; This is the undoubted result of experimental biology. (…) It does mean, however, that natural science does not possess the elementary conditions necessary for real knowledge of life. An immaterial or super-mechanical factor is inaccessible to all methods in the natural sciences"[294] (von Uexküll 1913a, p. 51). Weiss states: "Uexküll appears to regard this problem as beyond the due limits of the biologist, for he has to restrict his statements to what he actually finds in nature." (Weiss 1948, p. 48).

Ultimately von Uexküll's focus is on the lives of organisms, as the natural factor is beyond the reach of our comprehension: "According to Uexküll, limiting the scope of enquiry to the phenomenal world should have meant an increase in the accuracy and certainty of science, while the use of unverifiable assumptions and hypotheses regarding the sphere of noumenon

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unserer Umwelt eine Taste in der riesenhaften Klaviatur zu bilden, über die eine unsichtbare Hand spielend hinübergleitet.

[294] Die materiellen Faktoren reichen nicht aus zur Deutung des Lebens – dies ist das zweifellose Ergebnis der experimentellen Biologie. (…) Bedeutet er doch, daß die Naturwissenschaft die zur wirklichen Erkenntnis des Lebens nötigen Vorbedingungen nicht besitzt. Ein immaterieller oder übermechaniker Faktor ist allen naturwissenschaftlichen Methoden unzugänglich.

(for instance the existence of an unknowable natural factor) should only have been of heuristic and orientative value" (Brentari 2015, p. 54). Thus, as Brentari also says, the focus of the investigation is shifted: "Clearly, this does not exclude that the enquiry could regard the correspondence with a plan of the studied structures, their overall finality; according to Uexküll, though, that finality should be considered as a given, without searching which forces or factors ultimately established them" (Brentari 2015, p. 71).

In the end, in light of these assumptions, we can say that von Uexküll's claim is epistemological "because it determines what can be cognized and what status the cognition has (phenomenal)." (Pobojewska 2001, p. 326). "(…) the *Umweltlehre* [study of the surrounding worlds] itself is not metaphysics. According to Uexküll, its subject matter is the phenomenal world and not this which remains beyond the scope of being conditioned." (Pobojewska 2001, p. 332). These effects are an impression of the factor beyond our reach: "There certainly are realities which remain inaccessible to investigation, and of which we are able to form only a very dubious image, deduced from their activities." (von Uexküll 1926, p. 361).

Pobojewska points it out in a nutshell: "Nature, Life as such, is, according to Uexküll, the paraphenomenon, like heaviness about which we know nothing while we know something about the solids. Similarly, we know nothing about Life but we know something about living beings. Like Plato, Uexküll points to the existence of a transcendence resting at the basis of the phenomenal world which is a means of its objectivization. Unlike Plato, however, he excludes the possibility of getting to know this transcendence." (Pobojewska 2001, p. 332)

Lastly, how does von Uexküll's biological theory compare to the vitalistic theories that we have described? The issue is not easy to solve, and some may argue, like Pobojewska, that von Uexküll's ideas cannot be easily compared to the known vitalistic theories: "The basis for such a classification is provided by the category of the plan, this a priori of the subject which is basic for the emergence of subjective reality. Because of its immaterial character the plan is considered to be an irrational component. It is not noticed that the category of an a priori plan does not fit the scheme of solutions put forward by vitalism and mechanicism as it is derived from a different philosophical tradition." (Pobojewska 2001, p. 336).

In conclusion, we leave it to von Uexküll himself: "In this way, the consideration of the static Finality has also led us to the same result as the dynamic one. As soon as we leave the field of the mechanical functions of organisms already formed and we come to the consideration of their origin according to law, the same immaterial factor is presented to us, not as an

Aristotelian Entelechy, but as a Platonic idea. Wherever life originates, a non-physical law reigns, since physics simply knows the effect of the antecedent on the following in time; but never the reaction of the following in time to the antecedent. But this feedback always exists if we conceive of all existence as a given unit, as required by static teleology. It has been useless to dispense with Entelechy; instead of an immaterial factor, we have received a super-mechanical one. Material factors are not enough to explain life; this is the undoubted result of experimental biology. Only with the most extreme opposition will naturalists of the related sciences submit to this sentence. It does mean, however, that natural science does not possess the elementary conditions necessary for real knowledge of life. An immaterial or super-mechanical factor is inaccessible to all methods in the natural sciences. These internal differences of opinion will hardly concern the reader. But for him it will be, however, of the greatest importance that the natural sciences and philosophy finally meet.

If today three naturalists went for a walk together, it night happen that one of them was an Aristotelian, the second a Platonic, and the third a Kantian. 'To live is to bring an end in itself', the Aristotelian would say. Plato's disciple would let his gaze slide serenely over the tops of the distant mountains and would respond: 'Yes, a non-temporal end.' And Kant's disciple would silently nod."[295] (von Uexküll 1913a, p. 50-51)

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[295] So hat uns auch die Betrachtung der statischen Zweckmäßigkeit zum selben Erkenntnis geführt wie die dynamische. Sobald wir das Gebiet der maschinellen Funktionen fertiger Organismen verlassen und zur Betrachtung ihrer gesetzmäßigen Entstehung übergehen, tritt uns der gleiche immaterielle Faktor entgegen, nicht mehr als aristotelische Entelechie, aber als platonische Idee. Überall, wo Leben entsteht, herrscht ein unphysikalisches Gesetz, denn die Physik kennt bloß die Wirkung des Vorhergehenden auf das zeitlich Folgende, nie aber die Rückwirkung des zeitlich Folgenden auf das Vorhergehende. Diese Rückwirkung ist aber immer vorhanden, wenn wir das ganze Dasein als eine gegebene Einheit auffassen, wie das die statische Teleologie fordert. Es hat uns nichts genutzt, die Entelechie abzulehnen, na Stelle eines immateriellen Faktors haben wir einen übermechanischen erhalten.Die materiellen Faktoren reichen nicht aus zur Deutung des Lebens – dies ist das zweifellose Ergebnis der experimentellen Biologie.

Nur mit äußerstem Widerstreben werden die Naturforscher der verwandten Fächer sich diesem Spruch fügen. Bedeutet er doch, daß die Naturwissenschaft die zur wirklichen Erkenntnis des Lebens nötigen Vorbedingungen nicht besitzt. Ein immaterieller oder übermechaniker Faktor ist allen naturwissenschaftlichen Methoden unzugänglich.

Diese internen Meinungsverschiedenheiten werden den Leser kaum berühren.Ihm wird es jedoch von höchster Wichtigkeit sein, daß endlich Naturwissenschaft und Philosophie sich begegnen.

Wenn heutzutage drei naturforscher gemeinsam ins Freie wandern, so kann es sich treffen, daß der eine von ihnen ein Aristoteliker, der zweite ein Platoniker und der dritte ein Kantianer ist. „Leben heißt ein Ziel in sich tragen" wird der Aristoteliker sagen. Der Jünger Platos wird ruhig seinen Blick über die fernen Bergeskuppen gleiten lassen und antworten „Ja, ein zeitloses Ziel". Und der Schüler Kants wird schweigend zustimmen.

Appendix: Figures

(See Section 5.A.2)

Figure 1

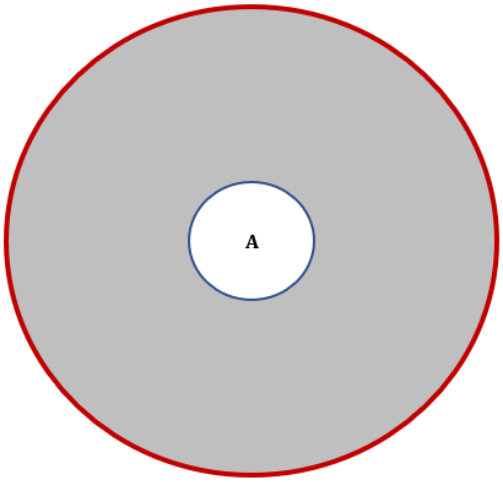


Figure 2

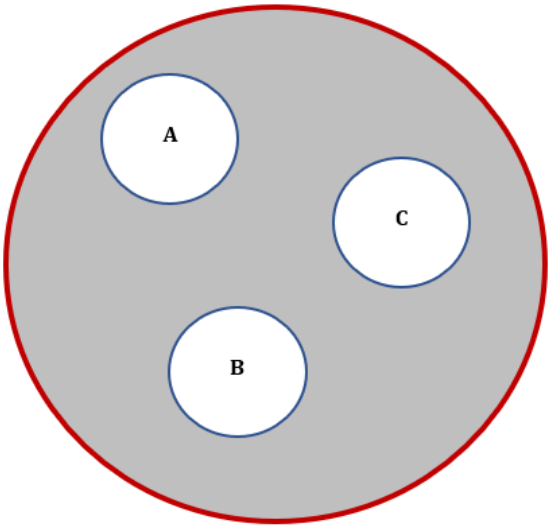
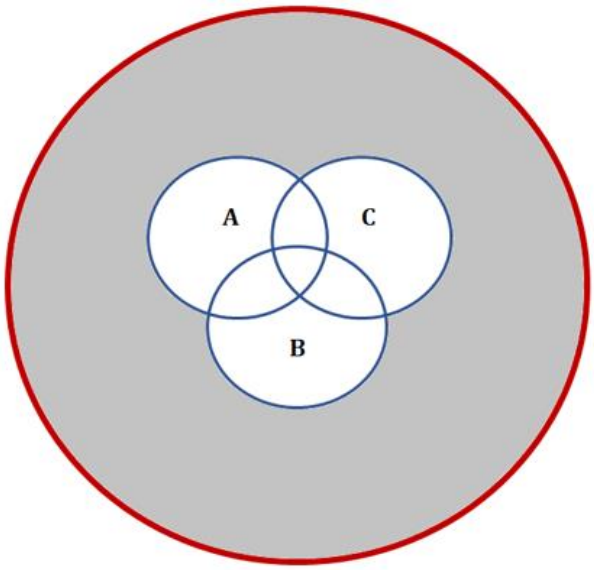


Figure 3



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