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0. Introduction¹

The term 'nature' is anything but clear. For Stoic philosophers, 'nature' was an all-encompassing entity and even a source of moral demands. Others thought that 'nature' should be contrasted with what was *not* nature, for example, technology or metaphysics. Today, we often contrast 'nature' with 'culture' or 'history'. For Christians the difference between the 'natural' and the 'supernatural' has in the past been crucial.

A new way of seeing things began in the 17th century, when scientists began to experiment and put their results in terms of quantification. According to Galileo the 'Book of Nature' is written in 'mathematical letters'. This was something altogether new, since before Galileo everybody thought that the 'Book of Nature' was a book of wisdom, not at all written in neutral mathematical formulas.

But the great success of modern physics led to the conclusion that everything which is important, could be expressed in terms of physics, in a modern sense.

German idealists such as Schelling and Hegel tried to reconcile modern physics with wisdom and speculation but in the long run, they were unconvincing, as were philosophers such as Bergson, Klages oder Teilhard who in the first half of the 20th century tried to deal with nature in a completely different manner than the established physics. Only as a result of the ecological crisis, in the second half of the 20th natural sciences were called into question as not describing the whole truth about nature.

If physics does not give us the whole truth about nature, the question arises, whether we require a new 'metaphysics of nature'? But first of all, we have to ask, what 'metaphysics' means, since this notion has come under attack since Kant.

Some philosophers like Jürgen Habermas think that metaphysics has been overcome, because we are unable to produce absolutely certain a priori-knowledge, while others like Donald Davidson claim that 'metaphysics' deals with nothing but the most common structures of language. This very weak form of metaphysics is widely accepted.

Within the philosophy of nature the meaning of metaphysics is different: 'Metaphysics' consists in believing that nature contains purposes, ends, values and so on. 'Nature' in this respect is not only a mathematical machine (as for Galileo) but at the same time a purposiveness whole, something which 'makes sense'. Everybody, who accepts Teleology in nature, is clearly a metaphysician.

Although the mainstream of modern philosophers and scientists deny that it is reasonable to use teleological notions with

¹ This lecture is a brief survey of my 'Philosophy of Nature', edited in Stuttgart (2002) in German, while it has also been translated into Polish. Note, that the decimal system used here for classification, does not correspond to that used in that book.

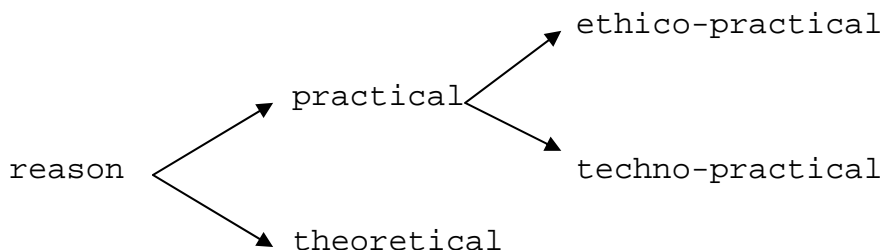
respect to nature, I will try to justify their use under certain restrictive conditions. This justification depends on considerations having to do with our practical relation to nature. It is often overlooked that our relation to nature does not only contain theories in physics, chemistry and biology, but practical relations regarding technology, morality and everyday-life intuitions.

Today it is quite unclear what 'Philosophy of Nature' could consist in. There are authors who have an existentialistic, Kantian, scientific, neo-scholastic, phenomenological or even mystical view of nature. They differ so greatly in content and in their presuppositions that they are scarcely comparable. This becomes worse if we go back in history. We even don't know, which authors are canonical. Do I have studied Aristotle, Kant, Schelling, Peirce, Quine, Popper and Carnap to know something about the 'philosophy of nature'? All this amounts to the fact, that 'Philosophy of Nature' does not yet exist. So we first have to ask, what it could really mean to speak of a 'philosophy of nature'?

But first of all, allow me to make some remarks about some basic topics of the philosophy and about the structure of this lecture:

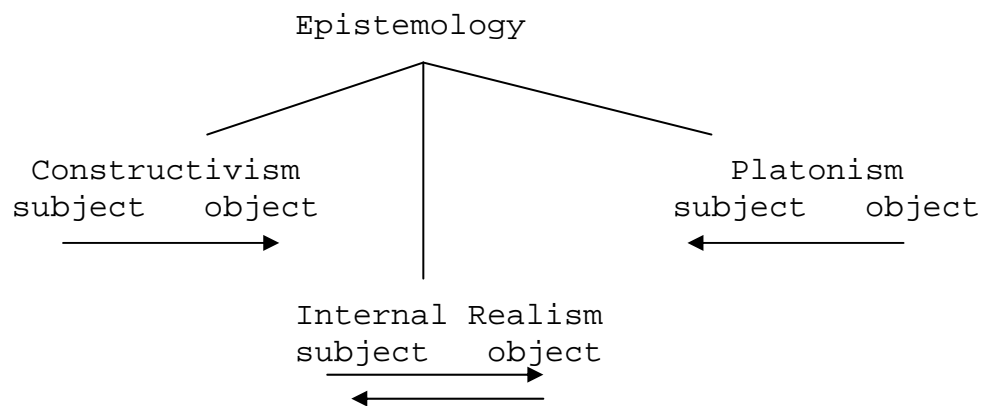
In the first chapter, I want to give a systematic survey of some very heterogeneous concepts of 'Philosophy of Nature' which we encounter in the philosophical literature today. In a second chapter, I want to make clear the tension between theory and praxis, regarding our notion of 'Nature', since we are always in danger of overestimating theoretical concepts at the expense of practical ones. I think, that 'Philosophy of Nature' should involve a union of both.

In chapters 3-5 I shall speak of nature as involving a *correspondence* between theoretical and practical reason, while I think of practical reason in a twofold way: ethico- and techno-practical. This are distinctions which go back to Kant or even to Aristotle who spoke of "theory", "praxis" and "poiesis". I think that this way of dealing with philosophical problems is very useful, so I will accept these classical distinctions:



The notion "correspondence" between practical and theoretical reason is very important. I use this term to mark my epistemological position. There are two epistemological extremes, which I reject in favor of a mediate position. The extremes are constructivism and Platonism. Every epistemology deals

with the relation between subject and object. For the constructivist all our cognitions depend only on subjectivity, while for the Platonist, every true cognition is objective and independent of subjective cognitions. Objects 'determine', so to speak, our cognitions. I think that both positions are false. Cognition consists in a sublime mediation between subject and object. It is true neither, that everything is constructed by the subject nor that everything depends on the object. A certain mediating position which I hold has been called by the Philosopher Hilary Putnam "Internal Realism". For Putnam, our cognitions are always cognitions from a certain perspective or from a certain viewpoint. But nonetheless, we are (contra Constructivism or Idealism) able to *really* know things. Cognition is not a dream.



In chapter three, I shall speak of nature in relation to theoretical, in chapter four in relation to techno-practical and in chapter five in relation to ethico-practical reason. Especially in chapters four and five, that I develop my metaphysics of nature.

1 Different Positions concerning Philosophy of Nature

To clear the confusion existing among widely differing sorts of 'philosophies of nature' that exist today it seems reasonable to distinguish between two fundamental different sorts of concepts.

First of all, there are authors who think that the term 'nature', designates either the totality of existing things or only a certain region of what exists. So we have a first pair of notions, which I call:

$$\text{Nat}_{\text{tot}} - \text{Nat}_{\text{reg}}$$

This distinction is indeed very simple: Some think, that by 'nature' we mean that which exists, while others reject this idea. They think, that 'nature' is just a special region of reality.

Another distinction concerns the scope of natural sciences. Are they able to offer a comprehensive explanation of every-

thing or are they not? If they are, we can speak of 'scientism'. If they are not, we think of a plurality of aspects in nature, while the natural sciences represent only one aspect. So we have a second distinction:

$$\text{Nat}_{\text{szien}} - \text{Nat}_{\text{plur}}$$

As I said, these distinctions are logically independent of each other, so that they are not mutually exclusive like 'day' and 'night' and 'good' and 'bad'. There are bad days and good nights, or bad nights and good days. Hence there are four possible positions:

- 1) $\text{Nat}_{\text{tot/szien}}$
- 2) $\text{Nat}_{\text{tot/plur}}$
- 3) $\text{Nat}_{\text{reg/szien}}$
- 4) $\text{Nat}_{\text{reg/plur}}$

This is not simply a matter of blind mathematical combination but I can show that these four categories are very useful in discussing real existing positions and in coming to grips with them.

For example $\text{Nat}_{\text{tot/szien}}$ is a position widely accepted by philosophers such as W.v.O.Quine, C.G.Hempel, W.Stegmüller, B.Kantischer and other 'physicalists', while $\text{Nat}_{\text{tot/plur}}$ is often accepted by great metaphysicians like Ch.S.Peirce or A.N.Whitehead. Those who think that these concepts of metaphysics are too strong in their basic assumptions, prefer the position $\text{Nat}_{\text{reg/szien}}$. In Germany $\text{Nat}_{\text{reg/szien}}$ is widely accepted by philosophers who reject reductionism with respect to the human person and who think that nature is mainly the object of natural science. So $\text{Nat}_{\text{reg/szien}}$ is a position held by authors such as J.Habermas, F.Kambartel, E.Tugendhat and many others.

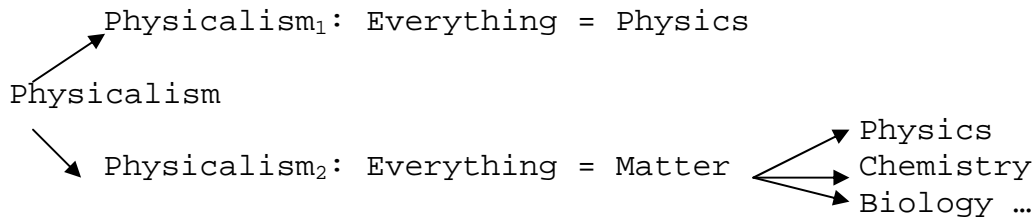
The position I prefer is $\text{Nat}_{\text{reg/plur}}$. This position is only held by a minority of philosophers in Germany and - as far as I can see - by *nobody* in the Anglo-Saxon world. But at least in Germany, there are an increasing number of philosophers, trained in both natural science *and* philosophy who accept this position for instance L. Schäfer, G.Böhme, C.Rehmann-Sutter, J.Soentgen, C.Köchy, G.Schiemann and R.Kather. So my position is not as exotic as it may seem at first glance.

I will deal with these competing positions one by one in the order mentioned above:

- 1) $\text{Nat}_{\text{tot/szien}}$
- 2) $\text{Nat}_{\text{tot/plur}}$
- 3) $\text{Nat}_{\text{reg/szien}}$
- 4) $\text{Nat}_{\text{reg/plur}}$

Nature as the totality of existing things, which can be adequately known by natural science (Nat_{tot/szien})

This position, which is called 'Physicalism' comes in two versions:² 'Physicalism' may refer to the objects of physics as a special science. This means, that everything in the world can be explained by physics alone. Another meaning of 'Physicalism' is 'Materialism'. On the latter view 'Physicalism' includes the natural sciences: biology, chemistry, physics as well as information theory or cybernetics. So we have:



This ambiguous way of dealing with 'Physicalism' is due to the fact that philosophers of science initially thought everything in the universe could be reduced to physics alone but this turned out to be impossible. So they changed their minds and developed what they called 'nonreductive Materialism', which today is also called 'Physicalism'. 'Nonreductive Materialism' claims, that everything in the universe can be explained by natural science but not by physics alone, since for example, biology can't be reduced to physics.

1.1.1 Nat_{tot/szien} as Physicalism₁: Everything = Physics

There were very famous physicists, like M. Planck or A. Einstein, who thought, that everything in the world could be explained by physical science alone. A physicist of our day, who still holds this position is the well-known Nobel Prize winner Steven Weinberg.

According to Weinberg physics will soon be accomplished to the point where we will have a mathematical formula which can describe all phenomena in the world even living beings or persons and this formula will contain the ultimate truth about the world since it will be logically necessary.

If we are in possession of such a formula Physicalism₁ would indeed be true. But it doesn't seem that we can have access to such a super-formula. For if we had such a formula, it would not be falsifiable. But a theory, which cannot in principle be falsified is not an empirical but a metaphysical theory. So Weinberg has shifted from empirical science to metaphysics without noticing it. This is what Immanuel Kant described in his 'Critique of Pure Reason' as the transition from categories to ideas or from the finite to the infinite. According to

² When I wrote my 'Philosophy of Nature', I only knew the first view, and I didn't see that the second meaning of the term is more important. So you will find nothing about this second position in my book.

Kant human beings have the tendency, to transcend the finite. Kant distinguishes between "regulative" and "constitutive principles". The principles of physics as an empirical science are constitutive, but our tendency, directed against the infinite is only a regulative principle, which means that it is a goal which we will never reach, but which is necessary for scientific research. But if we do not pay attention to keep this separated, we produce bad metaphysics, especially if we combine empirical science with this pretension of the infinite. And that's exactly the problem with Weinbergs 'ultimate formula'.

Physicalism₁ is not only a reigning conception of physicists like Planck, Einstein and Weinberg, but even since the days of the 'Vienna Circle', we have a long tradition of systematic reflection on physicalism beginning with thinkers like Carnap, Schlick, Neurath and ending with Hempel, Quine and Stegmüller. But this sort of physicalism has been rejected by materialists and reductionists themselves, because it can be shown that the principles of sciences like biology, systems theory, information theory can't be reduced to the laws of physics. So the idea arose that it would be useful to redefine physicalism as physicalism₂ that is: All the sciences are considered, that refer directly to material states. (This excludes such hermeneutic' sciences as history, sociology and psychology).

1.1.2. Nat_{tot/szien} as Physicalism₂: Everything = Matter

So Physicalism₂ is a sort of 'nonreductive Physicalism', that includes different natural sciences and claims that in this way, everything in the universe, including human beings can be exhaustively be explained.

Now the crucial point is human beings themselves. Everyone admits that some human qualities can be explained by natural science. Human beings evolved from nature, so they have many qualities in common with other animals. But they have also qualities, which are unique in the rest of nature, like morality, freedom, language and reason.

Whether all these features can be explained by biology is a difficult question that can't be treated here *in extenso*. Analytic Philosophers speak of 'Philosophy of Mind', 'Mind-Body-Problem' and so on. Here I can't repeat this vast discussion and all the arguments that have been put forward to show either that *qualia* and *intentionality* can't or can be explained by natural science, nor can I repeat what has been said concerning physical identity theories, nomological identity theories or functional or computer theories.

But as far as I can see, the program of Physicalism₂ failed. It fails for example with respect to the problem of 'qualia'. Or as Thomas Nagels puts it in a famous article: „What it is like to be a bat?“ Even a bat must have a feeling of it's own existence i.e. what it is like to be a bat, and we can't see how to replicate this feeling from the outside, for example if we

investigate it's brain or it's nervous system. There is no direct transition from the outside, accessible to natural science, and the inner feeling of a living being, which cannot be objectivated in the same manner.

But this is not the only reason, why physicalism₂ fails. Analytic Philosophers often limit themselves to the issues of intentionality and qualia, but there are also other human qualities, which cannot be explained with in terms of Physicalism₂. I already mentioned morality, freedom, language and reason, but we can also think of history, society and culture in general. It's hard to see how biology, for instance, could explain various sorts of cultural phenomena. This has been undertaken by sociobiology, but the results have not been very convincing. So we don't have good reasons, to accept Nat_{tot/szien} and we will go on to consider Nat_{tot/plur}.

1.2 Nature as the totality of existing things, which can only be known by a plurality of approaches (Nat_{tot/plur})

If you accept Nat_{tot/plur}, you think of nature as a whole with different aspects that cannot be reduced to one another by means of natural science. On the contrary you think that reality is so rich that you need both the natural and hermeneutical sciences as well as practices like ethics, politics and aesthetics to know what it is all about. If you accept this plurality of views, you will have tendency to ask the question: 'And what do all these different sorts of theories and practices have in common?' If you ask this question you are a metaphysician in the widest sense of the term.

Now I will deal with two great metaphysicians, who tried to answer these questions by means of natural philosophy. This is not the only approach to these questions. You could try to answer them within a Philosophy of Being like for example St. Thomas or within a Philosophy of Absolute Spirit as for example, Hegel. 'Being' and the 'Absolute Spirit' are not quite the same thing as 'Nature'. But there are philosophers like Charles Sanders Peirce or Alfred North Whitehead who tried to answer these questions by means of natural philosophy alone and we must ask ourselves whether this is really possible. We want to know, if a philosophy of nature is an adequate means to answer these fundamental questions.

First of all, it is important to see that neither Peirce nor Whitehead think of metaphysics as an apriori enterprise. There is an important rival tradition of metaphysics from Plato and Aristotle to Hegel. These opposing philosophers thought that metaphysics must rely on principles that are necessarily true. But Peirce and Whitehead think that this would be too restrictive. Metaphysics can be falsified like the empirical sciences. So they prefer a weaker form of metaphysics.

If you think of the unity of all things *in nature* you will have the problem that 'nature' is often and for good reasons defined by natural laws that are investigated by physics.

These laws depend on efficient causality. Kant distinguished sharply between efficient and final causality. For him, final (or teleological) causality is quite different from efficient (or nomological) causality. He believed there were certain analogies between the two, but no stronger connection. Even today we have philosophers who hold a so called 'dual-aspect monism', according to which we speak of mental states in a totally different language from brain states.

But philosophers like Peirce and Whitehead are monists for whom the laws of nature and the laws of action are in principle identical. In this way, they want to go back to Aristotelian philosophy. For Aristotle, there was no difference between causality in nature and in human action. He treated both according to the same causal principles.

How can we think of causality in nature and agent causality as identical? For Peirce laws in nature are like the habits of personal beings. There are persons, who always act in the habitually manner. Of course this is a bit monotonous, but according to Peirce, there is a transition between freedom and necessity. Persons, who habitually act in the same manner have lost their freedom, while other persons are more or less free and act in unforeseeable ways to different degrees. This is not only true for human beings but also for nature. Both obey the same dialectic of freedom and determinism. This means, that the laws of nature are at the same time teleological. For example, if a stone falls to earth, this falling is the purpose of the stone: 'It wants to go there'. Whitehead puts it the same way. For him the regularities, which can be observed by physics, result from certain constant purposes, which act in nature.

For both, Peirce and Whitehead, the laws of nature vary constantly, like the purposes of living beings. They think of the laws of nature as similar to the laws of composition in music. In musical composition, you have laws of harmony and counterpoint which vary in different places and epochs in history. But this way of putting things is mistaken. First, it is not reasonable, to think of physical laws as final laws. If you say, that a stone 'wants' to fall down to earth, because of habit, you can explain nothing more than by the causal law of gravitation. So, according to Occam's razor, you should not multiply reasons beyond necessity. Final causes are unnecessary here. Second, physical laws cannot be restricted to certain places and certain times. Physical laws don't involve indexicals like 'here', and 'there'. They don't refer to historical places or times, otherwise they couldn't be tested experimentally anywhere by anybody and at any time.

But the problems are even worse: a metaphysical naturalist like Peirce or Whitehead must not only identify efficient and final laws but he must even identify morality and causality. In the middle ages, philosophers thought of the 'lex naturalis' as a moral law. The 'lex naturalis' taught human persons, not to lie or steal or murder.

But things have changed. While in the middle ages, the 'lex naturalis' was a normative law, modern laws of nature are only descriptive. They don't prescribe anything. If you know the law of conservation of energy in physics, you know nothing about how to use energy. Today, we draw a sharp distinction between prescriptive and descriptive laws. They can no longer be identified. But that's what Peirce and Whitehead have to do. If 'nature' is everything, the laws of nature must at the same time be like the 'lex naturalis' of the middle ages. It is not enough to identify teleological and nomological laws. You must identify nomological and moral laws. Now it is true, that every moral law is at the same time a teleological law, but the contrary is not the case. If you want to have a lot of money you must be an egoist. This is a teleological law but certainly not a moral one.

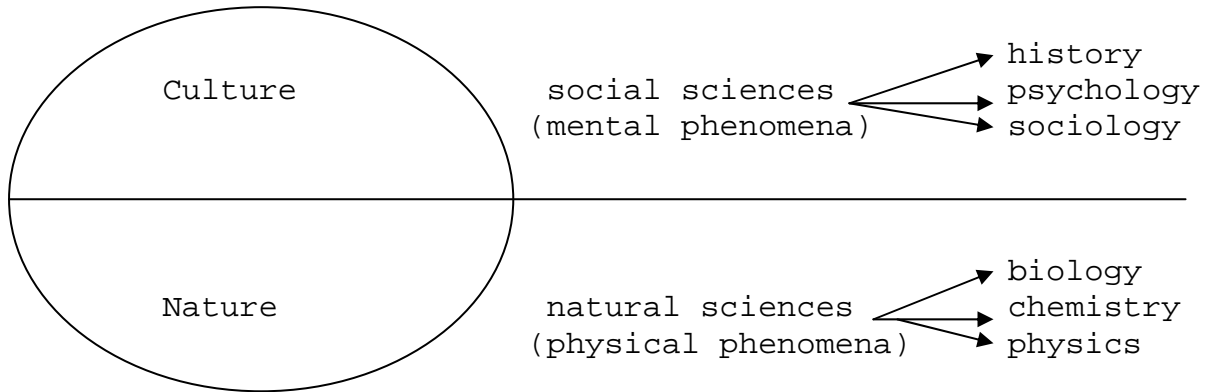
Now we can see that neither Peirce nor Whitehead ever identified teleological and moral laws although they should do so, since this is demanded by their metaphysical principles. Both were inconsistent on this point. They deduced their ethics from society and history, not from nature. So, with respect to ethics, they preferred Nat_{reg} , which is inconsistent with their principles, which namely rely on Nat_{tot} .

But there are other philosophers, like for Klaus Meyer-Abich, who tried to deduce prescriptive laws of morality from nature. But if you try to do this, you immediately see that it won't work. First of all, nature is blind, seen from a moral viewpoint. Nature is not a paradise but a battle field or a slaughterhouse. Think of a volcanic eruption that destroys animals, men and plants. If human beings act according to nature, this would have catastrophic consequences. This is why the best ethics, like those of Jesus or Kant, where anti-naturalistic. It is contrary to our nature to love our enemies and to obey the categorical imperative and not our passions. Nature is, as Hobbes says, "nasty, brutish and short."

Meyer-Abich on the other hand looks at nature as if a paradise. He speaks only of flowers, birds and lovely butterflies, but never of death, disease and suffering. So his perspective is very selective, while nature is cruel and blind rather than a source of morality. So it is unwise to see nature as a totality of existing things either in a scientific or in a metaphysical sense. This leads us to a third position which is very common among German philosophers:

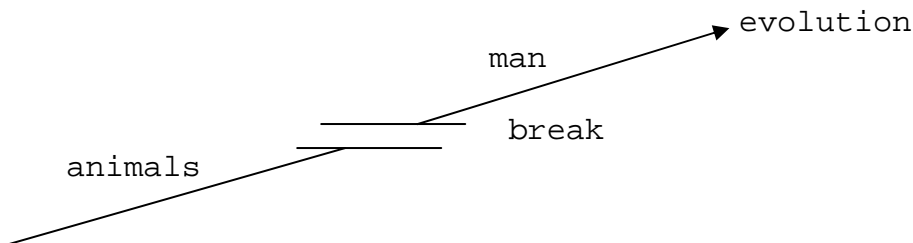
1.3 Nature only as a region, but one, which can be investigated completely by means of natural science ($\text{Nat}_{\text{reg/szien}}$)

Philosophers, who hold this position draw a sharp distinction between human beings and nature. If we characterize human beings in terms of the mental and the rest of nature in terms of the physical, we have no overlapping regions between the two. Instead you have two disjointed sets of existing beings and disciplines:

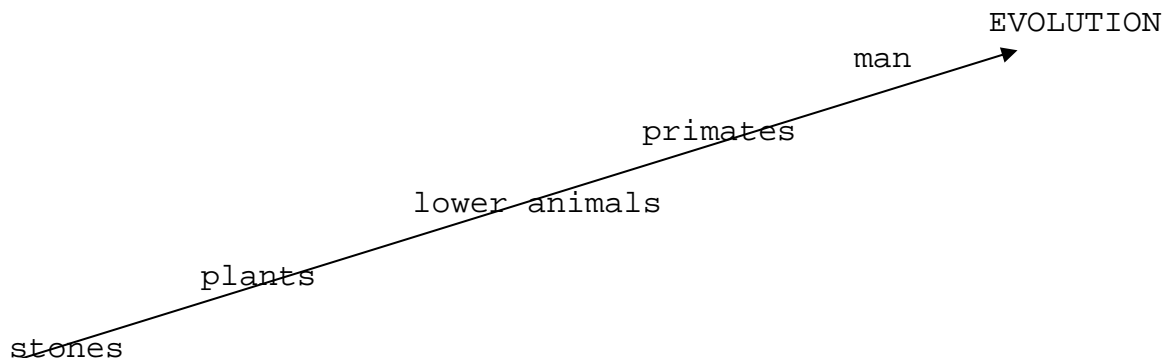


But there are phenomena which overlap in this pattern. Where do the chimpanzees belong? Chimpanzees have mental *and* physical features. And what about sciences, which investigate such disturbing fields as ethology for example? This conception requires a sharp distinction between social and natural sciences. But there are sciences, which belong to both. To be sure ethology belongs to both but so does information theory. Information has always three aspects, a syntactical, semantical and pragmatistical aspect. Neither semantics (in this sense) nor pragmatics can be treated within natural science, although some have tried to do so.

Now there are arguments of a similar kind which show that position $Nat_{reg/szien}$ can't be true. This position implies not only, that there are no overlapping phenomena between culture and nature but it also implies a sharp break in the evolution of living beings:



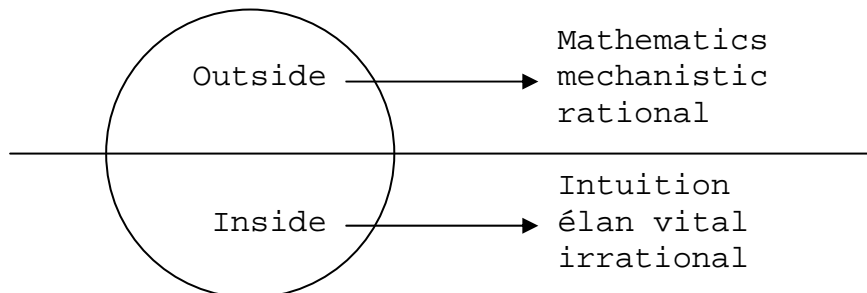
In this case, human beings came to be by a miracle with no analogies with the rest of nature, in contradiction to the Theory of Evolution. If Darwin is right, we have a continuity of forms, which doesn't exclude differences in qualities, but which implies analogies between the different forms:



If this is the case, the third position $\text{Nat}_{\text{reg/szien}}$ will not work, so that we have to turn to the fourth position:

1.4 Nature as special region, but one, that can only be seen from a plurality of startpoints ($\text{Nat}_{\text{reg/plur}}$)

If $\text{Nat}_{\text{tot/szien}}$, $\text{Nat}_{\text{tot/plur}}$, $\text{Nat}_{\text{reg/szien}}$ are all false, $\text{Nat}_{\text{reg/plur}}$ must not necessarily be true. Perhaps they are all false. We have now to investigate, if $\text{Nat}_{\text{reg/plur}}$ is valid. At first glance it would seem that it is not. $\text{Nat}_{\text{reg/plur}}$ takes nature to be something that can not only be investigated by natural science, but by other means as well. What could these be? Perhaps you remember Goethe and his doctrine of colours or you remember Schopenhauer and his doctrine of the universal will in nature. These positions sound very mystical and indeed, there have been numerous authors who rejected or at least confined scientific approaches to nature to a sort of mysticism or to bad metaphysics like with Bergson, Klages, Nietzsche or Driesch. $\text{Nat}_{\text{reg/szien}}$ is therefore only held by a minority of philosophers and this is very suspicious. Henri Bergson, for example, thought that nature has an outside, investigated by reason, mathematics and by experiment and it has at the same time, an inside that is not accessible to reason but only to intuition. It is like becoming acquainted with a person and knowing immediately, that he or she is a bad person or a trustworthy person. According to Bergson, we have such an intuitive insight not only to persons, but also to nature. There is an "élan vital" in everything that can be grasped only by intuition, not by reason:



The outside and inside of nature are clearly separated and don't interact.

But there is a great problem with such an approach: First, in philosophy, appeals to privileged positions are suspect. What about persons who deny that intuitions are possible with respect to nature but only for persons? Second, irrational principles are discounted. A principle must *ex definitione* be rational, otherwise it is no principle.

The problem with Hans Driesch and his 'Neovitalism' is quite different but also difficult. According to Driesch there is an 'Entelechia' working in living beings, while the rest of nature obeys physical laws. In living beings, the laws of physics are suspended. Now Driesch's 'Entelechia' was not an irrational principle, but one fully accessible to scientific in-

vestigation. Aristotle who invented the principle of 'Entelechia' thought that it was a final principle, which was present everywhere in nature and not only in living beings as Driesch thinks. Moreover, Aristotle didn't believe that these more fundamental laws are canceled by higher 'Entelechies'. They were rather fulfilled by them.

So Driesch's principle seems to be an ad-hoc-hypothesis in order to explain things that can not be explained by biology. In the meantime, everything that Driesch wanted to explain by his 'Entelechia' has been explained appeals to by ordinary efficient causality.

So $\text{Nat}_{\text{reg/plur}}$ seems to be a rather problematic position. Nonetheless there are an increasing number of philosophers who think that this position is all right. For example Lothar Schäfer and Gernot Böhme take as starting point the every-day-life-experience of the human body. According to them, our way of experiencing our own body links us internally with the rest of nature and opens a realm of experience that is very different from experiences in the laboratory of physicians and biologists. So here the practical experience of every day life is taken seriously and opens a new window to nature without being irrational or superstitious.

Since my own position is $\text{Nat}_{\text{reg/plur}}$, the rest of this lecture will serve to justify that position and I will approach the issue similarly to Schäfer and Böhme: it is important to take all sorts of practices very seriously. We always have tendency to overestimate theoretical approaches to nature and relativize practical experiences like every-day-life-experience, technical or ethical experiences and the like. But it seems urgent to take practical approaches as serious as theoretical ones.

2. The Tension between Theory and Practice

2.1 Methodological Considerations

The tension between theory and practice is similar to that between individuals and the society or between what we do and what we ought to do. Some philosophers think, that this sort of tension vanishes in history, but I don't think that it is the case.

To be sure: Theory and practice are always linked together, just like individuals and the society, but it makes a great difference, if you focus on theory or on practice and the mixture may differ by degrees. There are theories like mathematics, where practice plays no role. If you want to understand a mathematical deduction, it is not important to know the practical circumstances under which it was developed by the mathematician or its field of application. But if you want to understand the wiring diagram of a radio it is not enough to understand the physical laws the radio obeys (in this case Maxwell's laws). You have to know the practical purposes which the radio serves, such as the transmission of music or infor-

mation. On the other hand, there are capricious persons, who mostly act in an unforeseeable way. In this case it is neither possible nor useful to construct a theory about their behaviour.

So theory and practice are often related and intangled, but to different degrees and there are cases where theory plays no noticeable role or where you can disregard practice, without error.

When I speak of 'theory' with respect to natural philosophy, I am speaking of theories like physics, chemistry and biology. It is true, that all these sciences are often linked together with technology which is a special sort of practice, but you gain nothing if you know such technological applications in order to understand the theory. Albert Einstein for example knew nearly nothing about technological applications but nevertheless he was a very great physicist. Natural science describes facts which are often useful in practice, but that doesn't matter if you want to understand the theory.

Now, if you accept $\text{Nat}_{\text{tot}/\text{szien}}$ or $\text{Nat}_{\text{reg}/\text{szien}}$, you will be convinced that a theoretical approach is enough for nature. If you don't accept either $\text{Nat}_{\text{tot}/\text{szien}}$ or $\text{Nat}_{\text{reg}/\text{szien}}$, you must find another approach to nature which is logically independent from natural science. Since I reject irrational approaches or privileged positions, I must find another way to open a pluralistic approach to nature.

Now practice is something that everybody knows. It is neither irrational nor privileged. For example, if Schäfer and Böhme take seriously our bodily experiences, they are speaking of something very familiar to everybody and they can take this as a starting point for their philosophy of nature. The difference between practical and theoretical viewpoints is sometimes crucial. Take the following example: Somebody experiments with animals. From a theoretical viewpoint this may be fine. But from a practical viewpoint he has bad conscience. So you have a tension between theory and practice. A good natural philosophy must take practice as seriously as theory and this is, what philosophers who take positions like $\text{Nat}_{\text{tot}/\text{szien}}$ or like $\text{Nat}_{\text{reg}/\text{szien}}$ can't do. They think, that theory alone will do the job.

Now there are scientists who are aware of the fact that good science is not enough to master the problem of human practice. So they created a new sort of pseudo-Philosophy, called 'Popular Science'. 'Popular Science' has two meanings. On the one hand, it serves to explain complicated results of natural science to a public who has no time or no talent to grasp the meaning of say very complicated physico-mathematical formulas. If Popular Science plays this role of a mediator that's all right. But often Popular Science transports ideologies as well. Such ideologies are of great influence, especially when they are produced by well known scientist themselves. Some scientist cannot resist producing entire world views, for example, in order to replace metaphysics or even religion with

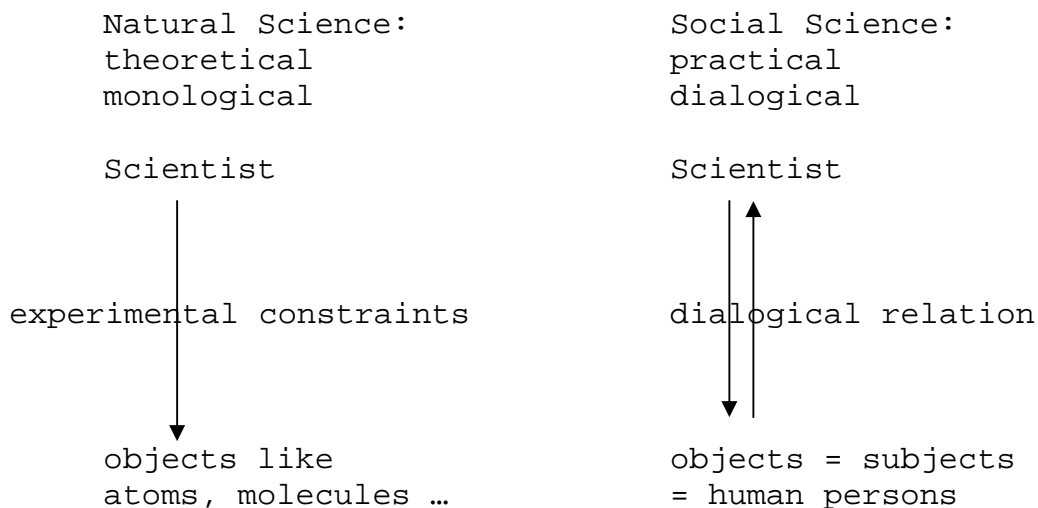
science. The well-known physicist Stephen Hawking for example, who is engaged in developing a Theory of Quantumgravitation speaks of this theory as of God's own plan before he created the world.

I will now mention several physicists, who expanded their physics far beyond its boundaries in order to grasp not only theory but practice as well. If they succeeded, an independent philosophy of nature would be superfluous and that's exactly what they want.

But philosophy can't be replaced by anything else. Philosophy is *sui generis*.

2.2 The Ambiguities of Popular Science

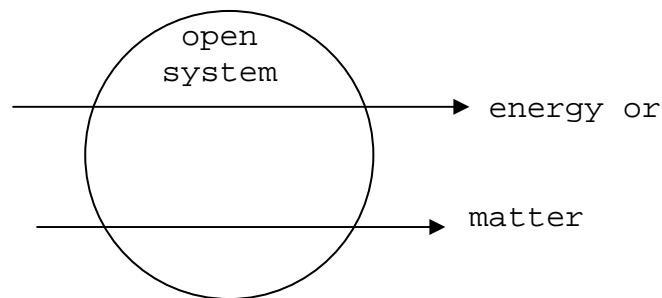
Many philosophers think that there is a difference in kind between natural and social sciences, even though there are also mixtures of the two like for instance, information theory. But we have to distinguish clearly in order to grasp the overlaps. So we may distinguish in an idealizing manner:



As I have said, there is a serious tension between the two. For example: It makes a big difference if a biologist thinks of an animal as a genetically programmed machine and adopts no further ethical commitments or if one treat ones dog or the cat in an analogous matter to other persons. Here, we have something like a 'dialogue' between living beings with clear ethical commitments. You may throw away an old machine. But you will hesitate to act in a similar way with sentient beings.

Now popular science (in its bad form) tries to combine theory and practice within science itself. What popular science wants to show is that practice has no independent meaning. As an example, we may treat with self-organisation-theory. (SOTh) SOTh was created some 40 years ago by Ilya Prigogine and Hermann Haken. SOTh explains how complexity emerges in nature. Some 50 years ago nobody knew how this could be the case, because at that time, complexity seemed to be very unlikely in

the physical world. Since the middle of the 19th century physicians knew the law of Entropy. According to this law, closed systems have a tendency to produce disorder. (Closed systems are systems with no external influences of matter or energy). The law of Entropy is quantitative. You can measure Entropy like temperature or pressure. If Entropy increases, disorder increases as well. This is the physical reason why complex beings have a tendency to decline. By way of contrast, SOTH explains in a clear mathematical way the opposed tendency of nature, to produce complex phenomena, but only within open systems that are mathematically described by nonlinear equations:



In open systems, you have the possibility of spontaneous emergence of complexity. Compare for example a normal lamp with a laser: In a normal lamp, you have electrons swinging without order and producing an incoherent electromagnetic wave while a laser beam is absolutely coherent. All electrons in a laser swing in the same manner. A second example is, for instance, certain patterns in the clouds which you can sometimes see in the sky.

But it is important to notice that SOTH describes only the emergence of a physical order not a technical or juridical one. Technically and juridically ordained systems depend on final causes while physically ordained systems depend only on efficient causes without a telos or purpose.

Now there are certain scientists, who mix these sorts of explanatory levels together because they want to suspend the tension between theory and practice. For example Ilya Prigogine wrote several books about SOTH, where he claims, that we no longer need the social sciences. One of his famous books is entitled: "Dialogue with Nature". As I mentioned, there is no Dialogue in Natural Science. Rather natural science depends on experimental results, which are monological in character and this is also true for SOTH.

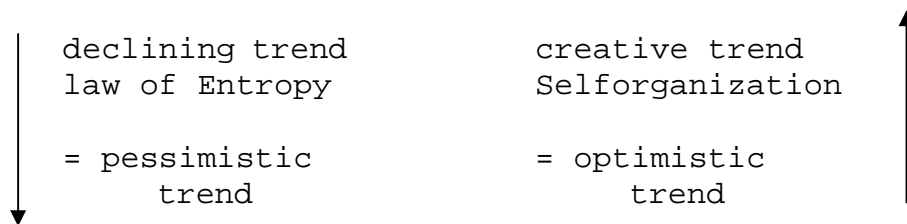
But according to Prigogine, SOTH shows us nature as acting spontaneously, insofar very small random events (on the atomic level) give raise to macroscopical effects. The coherence of a laser beam is, for example, caused by one single atom! But we must pay attention: Random events as causes of order are not the same thing as spontaneous actions of the free will! Prigogine on the other hand claims that in random events nature choose their own ends. But this is an anthropomorphic or me-

taphorical way of putting things. Prigogine often speaks in this manner. Such random events are for him "historical" events like events in human history.

This is bad metaphysics not empirical science. Two hundred years ago philosophy dominated empirical science and today it's nearly the opposite. But both pan-philosophy and scientism are false.

Nonetheless Prigogine had great success with his bad metaphysics. So for example the well-known physicist Paul Davies wrote a book about SOTh which was very influential among many social scientists and on theologians. In this book, he refers to SOTh as a "New Order in the Cosmos". For him, traditional physics is mechanistic and analytic while the new physics is creative and holistic. According to the new paradigm physical events are innovative and progressive.

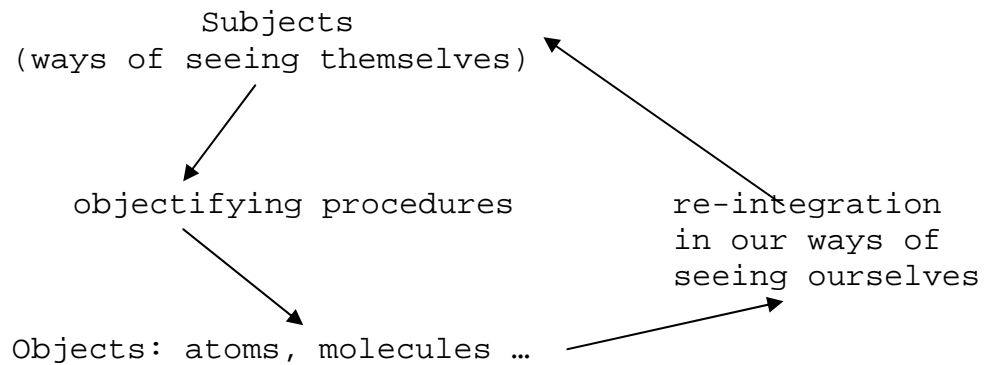
With reference to Prigogine, he speaks of "matter with his own will" and he claims in a teleological manner that in open systems, matter and energy strive for higher levels of organization and complexity. He even distinguishes two fundamental trends in nature:



He calls these trends "objective facts". But it's clear, that pessimism and optimism have nothing to do with objective facts. These two are human attitudes and physical events can only be described in this way in a metaphorical manner. If you claim, as Davies does, that these are literal truths, you produce bad metaphysics.

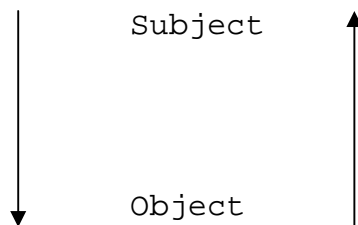
On the other hand, such metaphors may be useful if you are in search of a transition between theory and practice which is important, if human beings are viewed holistically and not in terms of substance dualism. Descartes thought of man as composed of two substances: A mental substance, called "res cogitans" and a physical substance, called "res extensa". The realm of mind is the order of final causes, whereas the realm of matter obeys the laws of efficient causality. So the dualism of Descartes separates completely theory and practice.

But viewed holistically, human beings are only one and the same substance, hence theory and practice must be linked together and we can think of Prigogines and Davies' metaphors as a sort of hermeneutics that refers to natural science and which combines scientific theories with the ways of seeing ourselves in our 'life world', a world dominated by practical reason. Human beings have always tendency to integrate their experiences into the way they see themselves. So we have a dialectics of understanding:



So the right side of our diagram describes something like a hermeneutics of natural science. Normally hermeneutics deals with texts and other cultural objects but I think that in a certain sense we can also speak of a "hermeneutics of nature" even with respect to a scientific approach to nature, which at first glance seems to exclude hermeneutics. But in a deeper sense I think we are able to relate hermeneutics to everything which exists but we can relate it to nature only within a metaphysical framework, not within the framework of natural science itself.³

This diagram is well-known from scholastic epistemology. Scholastics spoke of 'conversio ad phantasmata' and of 'reditio completa in semetipsum'. According to scholastic philosophers, knowing has always a double tendency:



While the left arrow denotes the way of natural science, the right arrow denotes the metaphysical 'reditio completa'. But it is quite impossible to identify both directions within natural science itself, as Prigogine and Davies try to do by means of Popular Science. If you speak of "optimistic" and "pessimistic trends" in nature, you are speaking in analogies in the sense of the scholastic "analogia entis", a metaphysical concept.

The tension between theory and practice can only be treated within a metaphysics of nature. There is no other way. As I said, metaphysics with respect to nature consists in the application of teleological categories. "Will in nature", "creativity in nature", "optimistic trends" and so on are either nothing but metaphors with no real scientific meaning or they are metaphysical in character.

³ I deal with such a hermeneutics in the sixth chapter of my book. This topic is missed out here in order not to inflate the lecture.

3 Nature corresponding to theoretical reason

If we speak of nature as corresponding to theoretical reason, we speak of natural sciences. That's how I have defined them. But why should this be important in a philosophical lecture? I always distinguish clearly between empirical science and philosophy. Empirical sciences of nature show us the causal mechanism of nature, while philosophy, as I understand it, reflects upon sense, meaning, finality, values, purposes and so on.

But there is still a philosophical problem with the empirical sciences of nature. As you have seen in the preceding chapter, natural science has tendency to make claims that are too strong and which cannot be fulfilled within natural science itself. So I want to criticize these claims.

3.1 Criticizing Scientific Platonism

We must carefully distinguish historical Platonism (or Neoplatonism) from modern scientific Platonism. Scientific Platonism developed only in the 17th century with the birth of modern science. This modern Platonism differs widely from traditional Platonism insofar as it is only theoretical (as I defined 'theory'), while traditional Platonism was theoretical and practical as well. In making these distinctions, I use the modern concepts of 'theory' and 'practice', not the ancient ones. For Greek Philosophers theory equals 'wisdom' which is not the case for modern empirical theories.

If we take this into account we may say that Platonic Idealism was at the same time theoretical and practical. The idealistic philosophy of Plato was based on two different foundations: Mathematics and ethics. Both seemed to have idealistic implications. Mathematics is clearly an a-priori-enterprise and neither can ethics be explained by empirical science since it demands humans beings act in a differently manner than they do by nature.

Plato thought that mathematics and ethics were rooted in the transcendent world of ideas a really existing realm. The material world of our sense experience by contrast was only secondary, more like a dream than like reality itself. So the ideas were real and they were at the same time the foundation of every true cognition. Being and knowing were identical in a transcendent manner and since 'being' was internally linked with values, Plato would have agreed with the Scholastic philosophers and their basic principle: "Omne ens verum et bonum."

But things changed dramatically in modern times. With the rise of mathematical science in the 17th century, Scientific Platonism was invented. It was especially Galileo, who opposed modern mathematical science to traditional Aristotelian metaphysics of nature. For Aristotle, mathematics dealt only with accidental quantities of beings. For him, these quantities we-

ren't as important as the qualities of beings, which were nearer to the 'forma' or 'entelechia', as he called the metaphysical essence of things.

Now, since Galileo wanted to establish a mathematical theory of nature, Plato was more important for him as was Aristotle and this signaled the rise of scientific Platonism. This sort of Platonism was not (and still is not) practical. It contains no ethics, not even technological imperatives. It is only a mathematical description of blind forces acting in nature that can now be quantified. But it was still held that mathematical formulas contained the true essence of existing things. Platonism became mathematical and this is the case even today. There are for instance, very important mathematicians, who call themselves 'Platonists' like for instance: Gottlob Frege, Bertrand Russell, Alfred North Whitehead, Kurt Gödel, Alonzo Church, Georg Cantor and many others. Physicians too are often Platonists. Beginning with Galileo, you have physicians who are Platonists such as Werner Heisenberg, Carl-Friedrich von Weizsäcker, Roger Penrose, Frank Tipler, Stephen Hawking etc. All these scientist think that physics contains the cognitive essentials of our world and this is the reason why position $\text{Nat}_{\text{tot}/\text{szién}}$ is widely accepted. $\text{Nat}_{\text{tot}/\text{szién}}$ relies on this sort of Scientific Platonism.

I don't accept Platonism for various reasons. First of all, I do not even accept traditional Platonism for its contempt of matter and the sensual world. But above all, I don't accept scientific Platonism because of its lack of praxis. A doctrine which contains only measurable quantities and mathematical formulae, cannot contain the cognitive essence of the world. I even claim that such a mathematical Platonism cannot even contain the cognitive essence of objects in nature such as stones, plants or clouds. Indeed, mathematical physics is very efficient in dealing with measurable quantities and with strict laws which the forces of matter obey. But it has its boundaries even within the physical world:

3.2 Physical₁ and Physical₂

Platonism claims that mathematical formulas, such as used in natural science, express the cognitive essence of physical objects. It is for instance often said, that water is *nothing but* H_2O , which means that water and H_2O are identical. But two things can only be identical, if they have the same main properties. If you buy, for example, a brand new car of just the same kind it doesn't matter, if the two were produced on Tuesday or on Thursday: These are the same cars.

But water and H_2O behave very different: Water is drinkable, while H_2O is not. If you drink H_2O , you will die because of the osmotic pressure in your inner organs. This is due to the lack of salts and other chemical substances in H_2O . It is clear, that water consists to a great extent in H_2O , but this is not the whole story, while the drinkability of water is so impor-

tant to our every day life, that it has become an symbol of life itself.

We could compare water with spoken language and H₂O with its grammar. Grammar is fundamental for syntactical correctness, but it is not identical with spoken language, nor is grammar the essence or nature of language. Grammar just contains the rules of our language game. It is not the game itself. So we may note a distinction between two concepts of 'physical':

Physical₁: goes back to the greek word "physis", which means natural phenomena as seen within our life world and expressed in ordinary language.

Physical₂: means natural events as described by mathematical physics in a formal language.

If you think for instance of an apple, you can think of it as a physical₁-object, a thing extended in space with certain properties (you can eat it).

If you think of the same apple in terms of physical₂, you think of its weight, mass or velocity in time and space. The physical₂-objects are abstract (you will never eat them).

Ordinary language and formal languages differ greatly. If you describe for example a physical₂-object by a differential calculus, you describe it by means of mathematical relations. Mathematics deals with relations, not with substances. Take for instance the following formula:

$$E = mc^2$$

This formula expresses the fact that mass and energy are proportional, c being the speed of the light which is a constant. The formula $E = mc^2$ does not tell me what energy and mass are, but only how they relate.

With ordinary language, it is not quite the same thing. Ordinary language does not deal with equations, but with judgments:

$$S \in P$$

You have a subject S and a predicate P . S represents a thing, while P represents a property of the thing. The property is ontologically dependent on the thing, but not vice versa. So, if $S \in P$, it is not true that $P \in S$. If an elephant is a mammal, it does not follow, that all mammals are elephants, otherwise a dog would be an elephant. While judgments are not reflexive, mathematical relations are. If $E = mc^2$, then also $mc^2 = E$.

This is the reason why I can only identify something as something by means of ordinary language but not by formal language. So if you want to express the fact that there are things

in the world forming the ontological basis of properties you have to use ordinary language.

There exists a widespread tradition in philosophy from Aristotle to Strawson, claiming, that categories like "substance - accident" or "thing - property" are ontologically fundamental, while physicalistic philosophers like Hempel and Quine tried to replace ordinary-language-judgments by mathematical relations. For Quine, there are no substances in the world, nor any properties, but only events. Physical₂-objects change in time, so the category of "events" is basic in physics. Quine holds $\text{Nat}_{\text{tot}/\text{szien}}$, but I think, we cannot replace ordinary language by formal language or to replace things and substances by events. We need both.

The decline of categories like 'things' and 'properties' in physics₂ can especially been showed in Quantum-Theory. In Quantum-Theory, we have a so called 'wave-particle-dualism', which means, that quantum objects differ according to our experimental setting. The same object can show itself as a wave or as a particle so that the difference between the two vanishes. For our life world this would be impossible. Here particles represent 'things', while waves are not things, but only properties of things. (Think for example of a water- or of a soundwave.)

It has often been said, that traditional categories like 'thing' and 'property' have been abolished by Quantum Theory, but that they are valid for Classical, Newtonian Physics. This seems to be so, because Newton expressed his insights often by using ordinary language, but not mathematics (which is astonishing). His 'second law' deals with the relation between force, mass and acceleration:

$$F = m \cdot a$$

Newton described this formula as if the force 'F' would be a cause, which urges the substantial mass 'm' to suffer a change of his movement, which means an acceleration 'a'. So he spoke of 'causes', 'effects' and 'substances'.

But this cannot be the meaning of $F = m \cdot a$. Causes and effects are irreflexive. If A causes B, B never causes A. But with $F = m \cdot a$ this is exactly the case. If $F = m \cdot a$, then also $m \cdot a = F$. Many relations in ordinary language aren't reflexive, while all mathematical equations are. Remember that, if $S \in P$, it is not true, that $P \in S$.

So ordinary language describes nature in a way quite different from mathematical language used in physical science. We always have to distinguish physical₁ and physical₂. When Newton described $F = m \cdot a$ in terms of causality and substantiality he thought of somebody acting in the physical world. But this is a practical viewpoint. He just confused theory and practice. For physics this practical viewpoint is for good reasons rejected. Practical purposes belong to technology and engineering not to theoretical physics. This is also the case for the

most important ontological principle that we call 'matter'. While everybody uses this word, it is quite unclear, what it really means. If we have to distinguish between physical_1 and physical_2 , $\text{Nat}_{\text{tot}/\text{szien}}$ and $\text{Nat}_{\text{reg}/\text{szien}}$ are false even for the physical world and not only for us, as I said above. But $\text{Nat}_{\text{tot}/\text{szien}}$ and $\text{Nat}_{\text{reg}/\text{szien}}$ are also false for the most important principle of natural philosophy: the principle of matter:

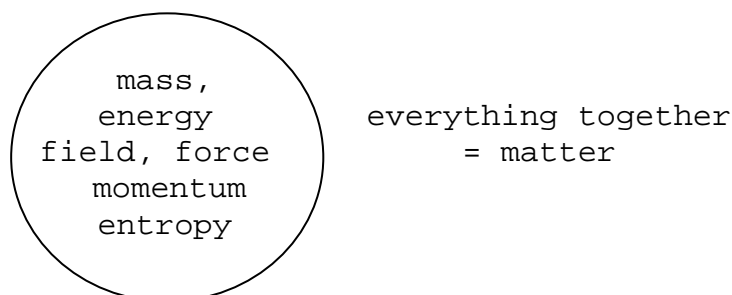
3.3 The principle of matter

Everybody believes he knows what 'matter' really means and everybody is convinced that physical science knows everything you have to know about matter, but both these convictions are false. Physical Science does not only ignore *de facto* what 'matter' means, but also *de jure*. The notion of 'matter' can't be translated into mathematical formulas.

The well known historian of physics, Max Jammer, wrote a book about the evolution of the notion of 'mass' in order to find the ontological basis of physics as a material substance, which supports the changing properties of this substance. But after some 200 pages, he resigned, which is not very astonishing, since 'matter' belongs to physics_1 , while 'mass' belongs to physics_2 . 'Mass' is quantitative concept. You can measure mass in gramme or kilograms, but 'matter' is a notion of ordinary language. In many investigations, 'matter' and 'mass' are identified, but they are different:

matter/	form:	Aristotelian	Metaphysics	=	physical_1
↓	↓				
mass/	force:	Quantitative	notions	=	physical_2

It was especially Johannes Kepler, who replaced the traditional notions of 'matter and form' by 'mass and force'. So he and Galileo created modern science. But if you replace 'matter and form' by 'mass and force', there is no way back to ancient ontology.



'Mass' can't play the same role as 'matter', for if you identify 'mass' and 'matter', all the other physical notions, like 'energy', 'field' or 'force' can no longer be material which is absurd. So, from the viewpoint of physical science matter means the totality of all physical_2 -phenomena: 'Matter' is not a *terminus technicus* of physical science.

If you are in search for 'matter' in physics, it is as if you were in search of mankind among different people in a town. 'Mankind' marks the totality of people, not a single one. This is why most textbooks of physics don't contain a clear definition of 'matter' which is also the case for many encyclopedias of philosophy of science. Normally you will miss the headword 'matter'. Everybody seems to know, what 'matter' is but in fact, nobody does.

If my analysis is correct, it has major consequences in many areas. For instance, in the philosophy of mind, most authors accept materialism and they rely on physics as the basis of their materialism. But if physics doesn't know what matter is, materialism can't be legitimated by science. Materialism is a philosophical doctrine, not a scientific one.

The notion of 'matter' doesn't belong to theoretical science, but it is an implication of our practical intercourse with the world. I think, that Aristotle was right. For Aristotle, matter is something that enables form to come into existence, while matter at the same time is something that resists formation.

Think of a craftsmen, who makes a table or a chair. The wood resists, especially as it has unforseeable qualities that have to be taken into account. We will see, that this is even true for modern technology.

But in most textbooks it is put otherwise. While 'matter' was for Aristotle a principle of randomness and individuality, a source of dissipation, something that cannot be computed, we use to ignore today these odd qualities in favor of strict laws, which we can compute. But even if we use all our scientific knowledge, matter can always behave in an unforseeable way, since all laws are only probabilistic. This is often the case with technological catastrophes.

Some 20 years ago there was a dramatic disaster with an US space shuttle 'Challenger'. After the takeoff of this shuttle, the booster rocket exploded and seven astronauts lost their lives. Those rockets are held together with washers (rubber rings), which are less elastic, if the weather is cold, as was the case during the takeoff of the booster rocket. So explosive substances leaked out and the rocket exploded. Everybody knew, that there was an increasing risk during cold weather, but the calculations were erroneous. The scientists computed the probability of a disaster as 1 : 100.000, while it was in fact 1 : 200.

After having found the mistake in erroneous computations, the disaster was 'explained', and everybody thought, it could be prevented for the future. But this was surely not the case. Even a disaster with probability 1 : 100.000 could happen tomorrow.

If technological disasters happen, the public will look for human faults. There must be somebody who is fault. You will never find that unpredictable qualities of matter are given as reasons. We are not aware of these dangerous qualities of

matter. From a physical₂ viewpoint it seems as if matter could be completely calculated and manipulated, but from a more practical physical₁ viewpoint, matter is at the same time a source of uncertainty.

So our theoretical views are very restricted. Within theoretical physics, we are unable to say what 'matter' really is and we are unable to see all the essential features of matter. So we have to make the shift to practical reason, if we want to see, what it is all about matter or with nature in general:

4. Nature corresponding to Techno-Practical Reason

In this lecture, I want to give good reasons for position $\text{Nat}_{\text{reg/plur}}$, which means, that I am obliged to find access to nature, which are logically independent of the natural science. This seems far-fetched. In 1.4, I mentioned Henri Bergson or Hans Driesch and their irrational or anti-scientific way to restrict the demands of natural science. This is not very convincing. So I have to find another way.

As I said, philosophy of nature consists in bridging the gap between theory and practice. But there are different ways of bridging this gap. I mentioned, for example, Gernot Böhme who takes as starting point our experience of the own body and who relates this experience to animals, plants and even to non-living beings. But this approach is rather speculative. So I will take another route:

If you examine different sciences that study nature, you will find some of them which are complete with practical aspects. Or to put it otherwise: there is much more metaphysics in empirical science as usually admitted. We often speak of 'natural science' in the singular. But this is not correct. In fact, we have sciences in the plural and these different sciences differ in the degree to which they objectify nature, which means, that they are penetrated with practical aspects to different degrees, so that they may contain metaphysics to different degrees. I will do nothing but make this metaphysics explicit. I claim for example, that you must have a metaphysics of nature, if you accept cybernetics or information theory.

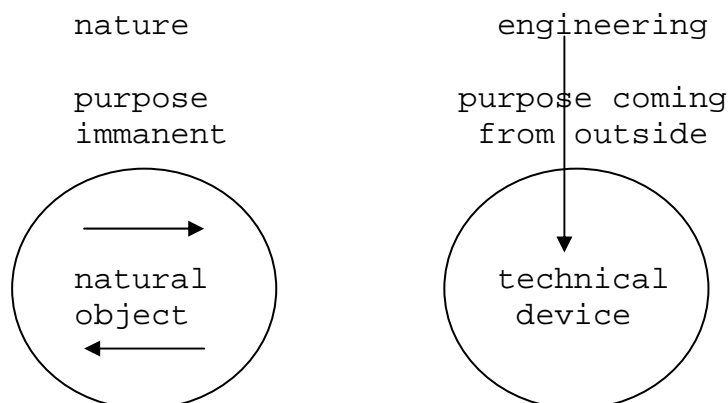
If you look only at theoretical physics, you will be able to objectify nature as much as possible and you have a very weak metaphysics. Philosophers from Kant to Popper claimed that the epistemological presuppositions of physics contain a weak metaphysics of knowledge. They claim that you must have metaphysical ideas in order to develop an empirical theory. But this position is only accepted by a minority of philosophers of science and even if it were true it wouldn't involve a metaphysical ontology, but only a metaphysical epistemology, which remains subjective.

In physics, you compute measurable quantities of nature with the help of mathematical formulas. This seems metaphysically harmless. But things change, if you shift from mathematical

formula to technological applications. For instance, if you interpret the human brain as a computer, you must take into account that the computer is not only a physical₂-object, but also a device which serves practical purposes. If you think of nature being analogous to technical devices, you think teleologically not only nomologically as in theoretical physics. (Remember, what has been said in 1.2)

So from a philosophical viewpoint, it makes a great difference, whether you use only neutral mathematical formulas in order to interpret nature or if you use purposeful devices as a model for natural objects or processes.

While many contemporary philosophers of science don't accept this distinction, Aristotle was very clear on this point. According to Aristotle, natural substances are at the same time similar to technical devices and unlike to them. Both natural objects and technical devices are purposeful but while for technical devices the ends or purposes are imposed from outside, natural objects have their source of acting and of their structure in themselves ('entelechia'). So, natural objects create themselves in a certain manner, while technical devices are created by somebody else:



So, for Aristotle, technical devices and natural objects are at the same time similar and dissimilar. He spoke of a "physis-techne-correlation". Today, this correlation is seldom taken seriously. But you will also find it in the works of Kant. By way of contrast, most contemporary philosophers of science ignore this distincture. For them, physical theories, computers, cars and robots are all of the same kind. But notice: I don't claim, for example, that animals are nothing but machines. They are machines in one respect: they function well. But they are not machines in another respect: they 'create' themselves, they are spontaneous, which is not the case for computers. But both are teleologically formed and both generate purposeful actions. This is enough to interpret technological devices as teleological models of nature.

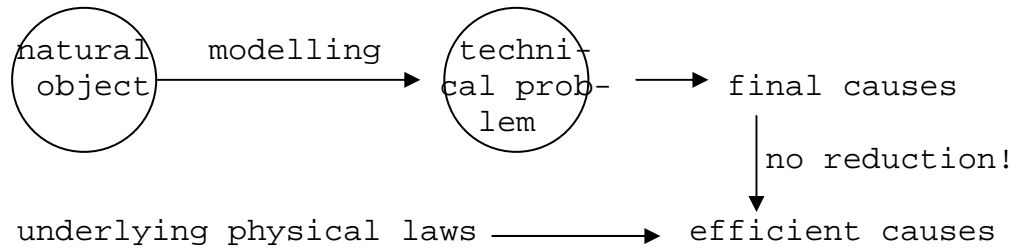
4.1 Bionics

With the help of bionics, I can show, that the "physis-technecorrespondence" is not overcome, as most philosophers of science believe. For those philosophers Aristotelian metaphysics is no longer valid. But I think that this judgment is superficial. 'Bionics' means a new scientific-technological procedure that originated in the 1960's in the US and travelled to Europe some 20 years later. In Bionics, engineers take optimizing features of nature as a model for human technological interactions.

Since nature has functioned for millions of years under conditions of extreme scarcity, 'products' of nature are very efficient with respect to their way of using energy, matter or in recycling. If you take proportions into account, the stability of a blade of grass is greater than that of a television tower or the energy efficiency input-output-relation is much greater for a sparrow than for a jet plane. Such efficiencies have been measured. Petrol motors have an efficiency of 13%, while there are some animals with an efficiency of 98%. An electrical kitchen stove has only an efficiency of 13%. No animal with such a modest efficiency could survive in nature. Glow-worms emit cold light, while we are still not able replicate this. Our incandescent bulbs still emit much more heat than light.

So in bionics, we take nature as a model for creating new or better machines. Claus Mattheck wrote a book with the title: "Design in Nature. Trees as Teachers." Remember: natural scientist rejected for at least 300 years "Design in Nature" and now it's natural science itself that speaks anew from 'teleology'! Mattheck shows in his book, how we can take trees as a model to optimize cars. If you build the motor of automobiles in an analogous way as trees are 'built', they become much less expensive, because they are not so heavy, stability remaining constant.

If you read books concerning Bionics, you will seldom find reflections on the underlying philosophical problems involved. The best known scientist in Bionics in Germany is a certain Werner Nachtigall, who wrote a book with Charlotte Schönbeck, in which you can find some philosophical remarks. For these authors, Bionics looks at natural objects "as if they had been constructed by a very talented engineer". The expression "as if" means, that there is no real purpose in nature. What we have to do, according to Nachtigall and Schönbeck, is to reduce the common structure of natural objects and technological devices to physical laws, which they have in common. But as we have seen, there is no possibility of reducing final causes to efficient ones. If we know the underlying physical laws of natural objects and technological devices as well, we do not yet know the purposes which are represented by them. If nature is a model for human actions and if these actions are governed by purposes, the same is true for nature.



So we have anew Aristotles' problem of the "physis-techne-correspondence". But we don't have a literal copy of the old pattern, since for Aristotle, nature was primary, while the work of the craftsman was secondary. Aristotle thought, that nature acted first and that the craftsman could only perfect what nature already begun. So technology was parasitic on nature. It produced nothing new.

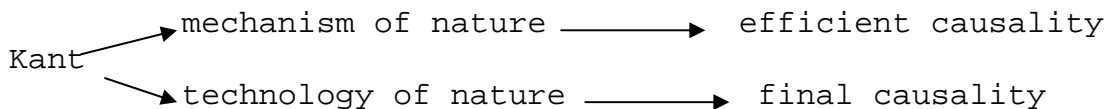
This is not the case with modern technology. Radios, rockets, computers and the like have no models in nature. Modern science has become autonomous and it is erroneous to claim like Frederic Vester, that nature has now become not only a model for engineering but also a model for ethics. This position has been rejected in 1.2, when I dealt with the position $\text{Nat}_{\text{tot/plur}}$. It is not wise to take nature as a source of morality.

4.2 Computer Science

In recent times the computer has become a paradigm for understanding the world. In the 18th century it was the clock which played this role. 250 years ago, everything was a clock like animals or men. The universe was a huge mechanism clock-like mechanism and God was a the Great Watchmaker.

Today, we think of animals and human beings as computers or robots. There are physicists like Paul Davies who think that the whole universe is like the hardware of a computer on which the physical laws are running as a sort of universal software and there is even a physicist like Frank Tipler who thinks of God as the great unprogrammed programmer.

The computer metaphor is not as harmless as it seems. If we take the computer as a model for understanding nature, we think in teleological terms not only in terms of efficient causes. With respect to the clock metaphor, Kant noted an important distinction:



Most of the modern authors don't distinguish between "mechanism of nature" and "technology of nature". But this difference is crucial. While a "mechanism of nature" only contains

neutral physical laws, a "technology of nature" contains purposes, ends and values as well.

The founder of cybernetics, Norbert Wiener, didn't distinguish between these two sorts of causality either. His first important book on cybernetics is entitled: "Cybernetics - Communication and Control concerning Animals and Machines." So Wiener drew no distinction between nature and technology. But from a metaphysical viewpoint this is very important.

In semiotics (the doctrine about signs), we commonly distinguish three levels:

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pragmatics → practical context
semantics → meaning
syntax → grammar

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While all these levels are logically independent they are internally linked in ordinary spoken language. For example, we are unable, to derive the meaning of a text from its grammatical structure. On the other hand, there are children who understand language correctly, without having the slightest idea about grammatical structure. Nor contains semantics pragmatics. Think of a chat room in the internet. People talk with each other without seeing each others bodies. But it is mainly the expression of our body especially of our face which marks out practical context. The internet only transports the semantics and that is why there are so many misunderstandings in this sort of communication.

The classical pattern of semiotics has been transferred to computer science. Sometimes they add a fourth level (the physical basis):

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pragmatics → practical context
semantics → meaning
syntax → 0110011..
physics → Maxwell equations

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(Maxwell equations are the laws of electricity. 0110011.. means the binary code of computer science.)

Here too, different levels are logically independent. For example, syntax is related to the physical basis by the 'principle of multiple realization'. One and the same syntactical structure can be physically realized by totally different devices, for instance by relays, tubes, transistors, integrated circuits and so on. Since everybody accepts the 'principle of multiple realization', the physical level of computers is often ignored for good reasons, because syntax and physics are logically independent. So are semantics and syntax. For exam-

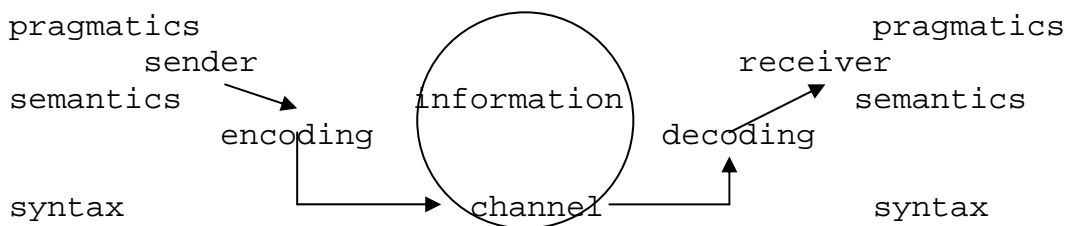
le, you can't derive the meaning of information from its syntactical structure alone. Take for example 0110011, this series may designate the word "Poland", a note in a piece of music or a triangle and what not.

In computer science the variety of these different levels is often ignored or reduced to a single one. It is especially the pragmatic level that is ignored. There are many encyclopedias of computer science, which have no headword 'pragmatics'. But as we have seen, it is always a mistake to ignore practical contexts.

In Analytic Philosophy and Cognitive Science, computers are often only interpreted as Universal Turing Machines. An Universal Turing Machine is only syntactically defined. It transforms, for example, the series 1001011 into 0010100. That's the whole story from a syntactical viewpoint. In this regard, the computer is nothing but a logical machine, so that we can compare computers with physical laws. It has been said, that our brain obeys logically defined laws in the same manner as planets obey physical laws when they move round the sun. From this standpoint it seems as if computer science was a reductionistic and materialistic enterprise.

But computers are not only logical machines. Information always has a meaning and information is always embedded in practical contexts. This has major consequences if you apply computer science to natural objects, as I want to show with respect to applications of computer theory to biology:

When in the 1950s Crick and Watson discovered the structure of genes, they described their behaviour in terms of information theory. This was the beginning of the use of information theory in biology. Today, we have scientists like Bernd-Olaf Küppers, who make use of the whole machinery of information theory in order to describe the behaviour of the genes:



The pragmatic and semantic aspects are only known, if you see information from the viewpoint of a sender or receiver, which means from the viewpoint of acting persons, for whom the message has a meaning.

On a technological level, you only deal with the syntactical aspect of information. When Shannon and Weaver founded information theory in the 1950s, they were only interested in technological issues. If you are an engineer and you want to transmit news by a radio station, for example, the content of the news and their practical context plays no role at all. It was for this reason, that in information theory the syntactical aspect was of greatest interest and this was also why

computers are often identified with Universal Turing Machines. This is not false, if we are only interested in technological problems, but it becomes very different, if we apply information theory to nature. Now we have to ask questions like: Who is the sender? Who is the receiver? For whom has the information any meaning? What about pragmatics? For whom is this information valuable? All these questions are easily answered, if there are acting human persons, to whom information means something, but what about nature, if this pattern has to work without existing persons?

These are the questions which Bernd-Olaf Küppers tries to answer in his information theory of biology. First of all, he is in search for physically definable values. According to him, the capacity of living beings to behave in a reproductive way represents the semantics of this natural process, while this behaviour is defined by a dynamic value-criterion.

But this seems a bit strange: Can there be values in nature? Perhaps, but not for natural science. Sometimes, Küppers takes information theory to be a combination of natural and social sciences. I think this is correct. But if it is correct, we can no longer claim that information theory in biology belongs to physics even if we agree that physics can be understood as physics₂, since even physics₂ is committed to efficient causality, while in information theory we have a mixture of efficient and final causality.

But it becomes even worse: Who is the sender and the receiver in nature? For Küppers, the information bearing living beings are the sender, while the environment is the receiver. The environment assesses the message according to values which are founded in the capacity of living beings to behave in a reproductive way.

What does it mean to say that the environment 'assesses'? This is no longer Darwinian Theory of Evolution. For Darwin the environment was only a passive filter and not an active agency, capable of 'assessing' according to certain values.

But it is especially difficult to define pragmatics within the scope of such an information theory of living beings. For Küppers the pragmatism must contain the action-theoretical contents, which are relevant for sender and receiver. Now Action Theory belongs certainly not to natural science. Action Theory deals with nothing but *human* actions and it is quite unclear whether we can relate this theory to natural objects. But if we can do so, we produce a combination of natural and social sciences and we presuppose a metaphysics of nature; this is always the case, when we combine theory and practice, dealing with nature.

Today we can see that several new sciences are emerging with very important metaphysical implications. This is not only the case for Bionics and Information Theory but also for the so called 'Artificial Life Science'.

'Artificial Life' (AL) was introduced some 15 years ago to contrast with 'Artificial Intelligence' (AI). AL allows us to

simulate evolutionary settings using a computer. It was founded by the mathematician John Holland with the help of so called 'Genetic Algorithms'. While AI deals with the simulation of human thoughts, AL deals with the simulation of actions of humans or animals. These actions depend on adaptive behaviour in order to maximize the possibilities of surviving.

If you want to simulate evolutionary processes on the computer, the individual living beings of a certain population have to be subjected to a criterion of fitness in order to see, whether they will survive or not. So you have to define a mathematical 'fitness function', which stands for the purpose of your artificial life-scenario. In such artificial populations, you simulate birth by copying and death by deletion. In copying, you allow the process to be influenced by random events, just as in nature. Even with the help of very simple Genetic Algorithms, you can simulate the behaviour of fish or birds in a swarm. It really looks very 'natural'. You can also simulate the pattern on the coat of animals like a zebra. Or you can simulate the behaviour of robots, who demonstrate something like 'fear' 'love' and so on.

But there is a philosophical problem ignored by most adherents of AL. The well known biologist Richard Dawkins simulated evolutionary processes long before John Holland. His computer created artificial 'animals' on the computer screen and then Dawkins choose the 'nicest animals' to survive and deleted the nasty ones. But after some time Dawkins was aware of the fact that in nature there is no acting agency like himself. So he let the computer make the choice. In this way, he thought he could get rid of the problem of final causation.

But I think he was mistaken, if he believed, that in this manner the problem of purposes in nature had vanished. Even if you let the computer make the choice, it's still you, who represents the teleological agency, since you have programmed the computer in order to make the choice with the aid of a fitness function. You just remove the teleological agency. It's impossible, to abolish it by this means.

So in each and every case, in the case of Bionics, Information Theory in Biology or in the case of Artificial Life, you have a problem with purpose in nature. These sciences, or rather technologies, depend on a combination of theory and practice, efficient and final causality and they show us nature in the light of purposes and values. There is much more metaphysics in modern science as the scientist themselves concede and we are still dealing with the Aristotelian "physis-techne-correlation", which has by no means been overcome.

Most of the AL-authors don't distinguish between living beings and artificial devices. Remember: For Aristotle living beings were not created by an engineer, but they emerged by themselves in a spontaneous way. If we don't accept spontaneity in nature, there is no distinction between living beings and technological artifacts. In this case, we could make use of living beings without ethical commitments. Living beings would

be morally neutral, we could use them like cars and computers. But this seems very contra intuitive. So we have to make the shift from a techno-practical viewpoint to an ethico-practical one:

5. Transition to Ethico-Practical Reason: Philosophy of the living world

In the last chapter we saw that living beings can be interpreted as machines, without being machines. Aristotle called this the "physis-techne-correspondence". This means that both, technical artifacts and living beings can be understood in a teleological manner, but in different ways: the technological artifact is created by an engineer who is external to the system, while nature creates itself in a self-organizing process. So we find certain forms of spontaneity and autonomy in the living world that do not exist in the realm of technology. This is the reason why even very young babies who are not yet able to speak, are capable of making clear distinctions between living and non living objects. Within the biological domain this difference does not exist.

Richard Dawkins calls living beings "survival machines", and in doing so he levels the difference between technology and biology. This seems far fetched, since - as we have seen - even a young baby (yet not able to speak) knows the difference. However, biology is committed to functional thinking and in this perspective there is - arguably - no difference between living and non-living machines. Departing from this diagnosis, I will demonstrate in this chapter the boundaries of Darwinism. But I won't do so like the adherents of the 'Intelligent Design Movement'. This movement is convinced that Darwinism is incapable of providing a full account of the existence of the different forms of life and that we should fill the existing gaps in Darwinistic theory by final causes of a specific kind. This does not seem reasonable to me. After all, final causes belong to Metaphysics, while efficient causes belong to empirical science. That is why it is by no means wise, to mix them up. So if we speak of 'the boundaries of Darwinism', we do not claim that the well known mechanisms of evolution were no longer valid. But we deny that Darwinism is the whole story and we insist on the fact that Darwinism should be balanced by an evolutionary metaphysics. Now, what concretely are the boundaries of Darwinism?

First of all, think of human persons, whose qualities are so rich that it is hardly believable to conceive of ourselves as nothing but survival machines. Even Dawkins himself admitted, that human culture relies on other principles than Darwinism alone. While Darwinian evolution is based on the genes, cultural evolution is based on what he called 'memes'. By "memes" he means highly speculative patterns of behavior or of thinking, that are propagated by imitation in a sort of Lamarckian cultural evolution.

The boundaries of Darwinism became clear with respect to Sociobiology and Evolutionary Epistemology. They deal with human behavior and human cognition but only in terms of evolutionary success. So they claim that human behavior and human cognition are advantageous in our struggle for more offspring. This seems highly improbable. There are many qualities of human beings that just do not fit in this pattern. Let me just mention two of them: Concerning our actions, we always obey or disobey certain norms. There has never been a human society on earth without norms. Now if you can obey or disobey such norms, you are free to do so. But we have no reason to believe, that animals are free. They *must* act according to their genetic programs. It has often been said, that animal parents behave altruistically towards their offspring. In a certain sense this is true, but there exists a difference: Animals are unable to refuse altruism which means animals cannot be bad and since they cannot be bad, they also cannot be good. Morality is not a question of biology but presupposes the existence of the capacity to choose freely between actions. The same holds true for Evolutionary Epistemology and its claim that human cognition is nothing but an adaptation that strengthens reproductive value. Human cognition is either true or false. It is committed to truth in the same way as our actions are committed to the good (in a moral sense). Truth on the other hand is not the same thing as efficiency. Darwinism can only speak of 'efficiency' with respect to reproductive success. But efficiency and truth are not identical, since there are truths that do not lead to efficient behaviour like our consciousness of being mortal and there is efficient behavior that does not rely on truth, like the so called 'placebo effect'. So efficiency and truth are logically independent principles that cannot be reduced to one another. There are still more arguments that speak against restricting human behavior and cognition to means to survival and reproductive success. But if we take the difference between animals and human beings for granted we may still ask, if animals (at least sentient beings) are nothing but genetically programmed machines as described by Darwinistic theory. This seems problematic, since humans have emerged out of the animal world and it would be astonishing, if human beings were totally different with our emergent qualities. Did they come out of nothing? Remember that I blamed position Nat_{reg/szien} (chapter 1.3) for making a sharp cut between animals and human beings which is not compatible with the continuity of evolution. Now, do we find any qualities in the animal world, that cannot be explained by the Darwinistic approach? I believe that this is the case, indeed. Think for instance of the chimpanzees. They are clearly able to have interests and to show them, which means that they are teleological agents. Ethology, the study of animal behavior presupposes, that animals can have interests. Many ethologists believe that animals have convictions, needs, desires and so on. In this case we

cannot restrict purposeful actions to human beings, nor can we restrict them to apes only.

It's not only the irreducible character of interests which does not fit into the Darwinistic pattern; furthermore it has been doubted whether functions are really nothing else but adaptations. If they were only adaptations, this would bring about severe consequences: it would prove false the claim, that we can reduce final causality to efficient causality. The case has been treated by several philosophers of biology like for instance Georg Töpfer, Peter McLaughlin and others.

McLaughlin for instance makes a simple thought experiment: Imagine a so called 'swamp mule'. This is a fictive animal that emerged spontaneously from the swamp without being a natural descendent of parent donkeys or horses. Mules are infertile, so the swamp mule has neither an evolutionary past nor a future. So by the principles of Darwinism he could not be the bearer of functions. But this seems to be absurd, since his heart has still the function to pump blood or his lungs have the function to supply his body with oxygen and so on. And this means that 'function' and 'adaptation' are two logically independent notions and that it is impossible to deduce functions from adaptations.

If this is the case, we must look for another explanation of functionality. The traditional view was to think of reproductive success as the ground of functionality. But this fails. So McLaughlin proposes the self-reproductive character of living beings as a ground of functionality. (This has already been put forward by Kant in his "Critique of Judgement"). "Self-reproductive character" is a feature of living beings often overlooked in modern times, but important in a traditional concept of living beings. Living beings are interested in their own welfare. They have - according to Aristotle - their own good. They exist for their own sake, or in Kants words, they are *autoteleological* (selbstzwecklich). If this is so, living beings are morally relevant. If according to the traditional view living beings are nothing but survival machines, we have no moral obligation whatsoever towards them. Machines are not morally relevant. But if living beings have their own good, they are morally relevant. I will deal with this topic in detail in the last chapter of my lecture.

If we admit the existence of purposiveness, intrinsic value and so on in nature, we might still ask how this can be compatible with the randomness of mutations. Is not chance the motor of evolution? Did not Aristotle himself oppose randomness and purposiveness as A and non-A. So if chance in nature is the source of novelty, does this not contradict the claim that there is purposiveness in nature? Would not this rule out teleology? And, can this allow the conclusion that God is ruled out as well?

But all these thoughts are deeply misleading, because we do not have the right concept of 'chance', 'randomness' or 'accident' available yet. These notions are hardly ever well de-

defined. First of all, 'chance' means nothing that occurs in time and space. It does not exist like sparrows, computers or cell phones. You cannot point with your finger to something and say "This is chance" (this is why we never do). Instead, chance is something like truth. Truth also does not occur in time and space as a single object. Only judgements can be true. So truth is not the quality of things but of our way of speaking about things. And this holds also for chance. If we say "Something happens by chance" we want to say that something does not fit in our way of ordinary explanations. Our *theory* fails. So chance is - as is truth - a property of speaking about the world, not of the world itself. Everything that does not fit in a theoretical pattern is called 'chance' by us and since we have different theoretical or even practical patterns, chance in one respect may be something different from chance in another respect. If you say for instance "Singular events as described by Quantum Theory occur randomly" you speak of another form of chance as if you say "Recently I met my friend by chance". The first sort of 'chance' is defined by natural laws and the second by human actions. So there are different sorts of chance, according to the context in which they occur. This means that one and the same event can be described in one reference frame as deterministic and in another as a random effect - without bringing about a contradiction.

Here is an example: Mutations are called 'random' because they are not ordained to the context of functions, that play a decisive role in the structure and behavior of living beings. But they can easily be produced by deterministic physical processes as for instance by electromagnetic waves of high frequency. So one and the same mutation is random with respect to biology and determined with respect to physics.

It even occurs that one and the same process is random from a physical viewpoint and purposeful from a viewpoint of practical action. Take an example: A huntsman wants to shoot a rabbit. Now rabbits are able to change direction abruptly so a normal rifle will not be useful. In this case so called 'shot guns' are used that shoot many bullets shooting at one time. These bullets behave in a so called 'bell shaped curve' invented by Gauss. According to this the direction of a single bullet is not determined, but completely randomly. So if the rabbit is shot, it's by chance from a physical viewpoint, but nonetheless there is a purpose behind it, because the huntsman wanted to kill the rabbit. So purpose and chance do not contradict one another. We have no reason to believe that random effects as described by evolutionary theory necessarily exclude teleology.

If teleology in nature is such that the living being can have interests, these interests are first of all for food, reproduction, defense, attack and so on. But on the other hand all living beings are interested in their own welfare. They have their own good which means that they are not only, like machi-

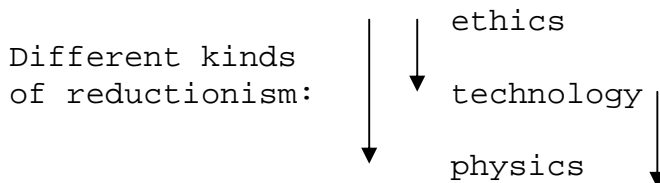
nes, a function of something else. They are 'autoteleological', which means ends in themselves and this leads us to a new aspect of nature:

6. Nature corresponding to Ethico-Practical Reason

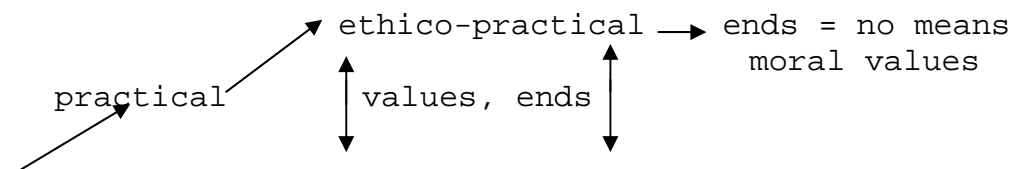
6.1 Methodological considerations

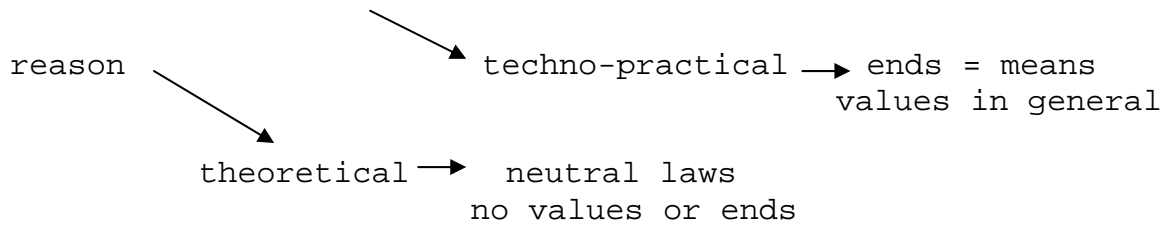
As we have seen, natural science always has the tendency, to require even those aspects that can only be grasped with the help of practical reason. We saw, for instance, that the notion of 'matter' is not a terminus technicus of theoretical physics but a principle which comes only into play within techno-practical circumstances. Or we have seen that overwhelming metaphysical claims cannot be dealt within popular science.

Since we have always tendency to underestimate practice this holds also for ethico-practical questions. As for those questions we often try to reduce them to techno-practical ones just as we have tendency, to reduce techno-practical questions to theoretical ones. This is the mainstream of reductionism in our culture. It was for example 'Artificial Life Science' that tried to reduce living beings to artifacts.

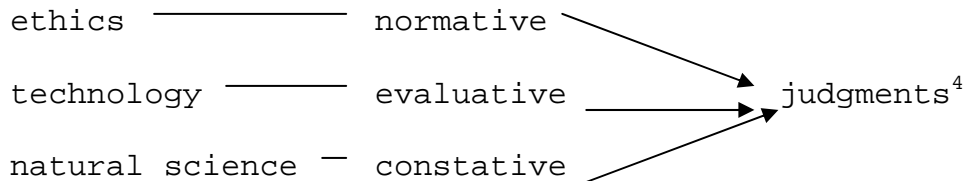


But there is an important difference between the ethico-practical and the techno-practical viewpoint, so that they can't be identified. Ethics deals with ends, which are not means, while technology deals with ends, that are means to even higher ends. If we claim, for example, that persons have to be respected, it makes no sense, to ask 'And what is respect good for?' To respect somebody makes sense in itself, and the same is true for love or friendship. The most important ethical values are valuable in themselves, which is not the case for technological values. If you want to manipulate everything in the world by means of technical devices, you can always ask 'And what are those manipulations good for?' In this case you could answer: 'Manipulation creates means to a better life'. So manipulation though in itself an end, can be a means to a still higher end. That is why technological values are not values in themselves as is the case for ethical values. So we may remember the introduction of this lecture and relate a fundamental pattern to ends and values:





These three different viewpoints have also been expressed in the form of logical judgments. So we have:



The reductionist tendency wants to reduce technology to natural science and ethics to technology or even both to natural science. But this is impossible on logical grounds alone. You can't derive an evaluative judgment from a constative one nor a normative from an evaluative one. If you say 'People do their work', this might be true even if it is bad to work, since you get tired of it. But instead of making a constative judgment, you could make an evaluative one, because you think, that it might be good to work, in order to earn some money. So you have a different judgment: 'It is good to work.' But this judgment, although it is evaluative, does not imply that you must do your work in a moral sense. It could be the case that somebody lives alone in the woods without working. To live in the woods is not a matter of bad morals.

Now before dealing with ecological ethics which is the main topic of this chapter, I want to show, that the reductionist tendency fails. Even reductionists themselves are not able to make nothing but evaluative judgments and to avoid normative ones. Ethics is *sui generis* and we are not able to abolish the moral viewpoint, as can be shown with respect to many authors, who try to do so:

There is for example the philosopher of technology Günter Ropohl who claims that nature is nothing but matter, that can be treated arbitrarily (he accepts $\text{Nat}_{\text{reg/szien}}$). Especially since there are no intrinsic values in nature. But sometimes he changes his mind and complains about the mutilation of the genetic heritage of nature by genetic engineering. But this seems contradictory. You can't mutilate matter. You can only

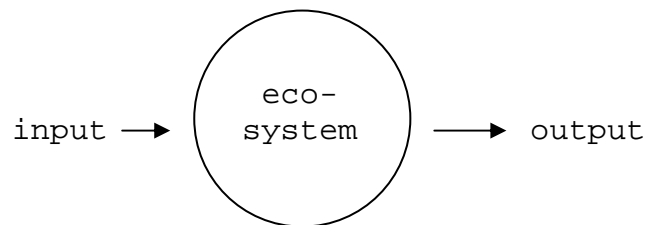
⁴ I don't want to make things too complicated. There are normative judgments, which don't belong to ethics. For example: 'You should use papers of the size of 21 X 29,7 centimeters.' If you use papers of the size 10 x 10 centimetres, you make no *moral* mistake. There are also evaluative judgments, which do not belong to technology like for instance 'It is good, to eat apples'. It only works the other way round: every ethical judgment is normative or every technological judgment is evaluative and so on.

mutilate something or somebody who or which has intrinsic values.

You will find such contradictions often in biology, when biologists accept $\text{Nat}_{\text{tot}/\text{szién}}$ or $\text{Nat}_{\text{reg}/\text{szién}}$ and when they are unable to avoid moral viewpoints with respect to nature.

The well known biologist Ernst Mayr, for example, thinks of nature as a realm governed by laws, which constitute nothing but efficient causes. But sometimes he speaks of the "right to exist of millions of species of wild animals and plants." How can something have a right to exist without representing at the same time intrinsic values? Can you speak of the 'right to exist' of gravitational forces or light rays?

In 4.2 I spoke of the biologist Richard Dawkins, who is an austere reductionist and materialist. For Richard Dawkins, plants, animals and even men are nothing but blind programmed genetic machines. In a book, entitled "The blind watchmaker" he thinks of the evolution as system, which generates living beings only by chance. There are no values or ends in nature. Nature makes no sense. But on the other hand, he worries for example much about cooks who throw living lobsters into boiling water in order to eat them. But why worry about this if animals are nothing but blind programmed genetic machines? You will find such contradictory claims also in ecological systems theory. This sort of systems theory resembles much to theoretical physics in the realm of biology. Ecological systems theory investigates input-output-relations in a quantitative, mathematical manner:



Often the output is computed in a difficult way by vector-functions or matrices. Take, for example, a lake as an eco-system and the influx of poisonous substances as input and changes of animals and plants in the lake as the 'output'. You may, for example, be interested in the resistance of living beings to such substances. Now ecological systems theory contains nothing but 'if-then' lawlike relations just as in physics and just as in physics, you don't deal with values or ends. Ecological systems theory is a theoretical science not a practical one. But if you read books about ecosystems theory you will find contradictory claims. For example, Bruno Streit demands that we should restore disturbed ecological systems and transform them into a 'natural' state. But it is clear, that the term 'natural' designates an intrinsic value, since nothing can be 'disturbed', which does not represent an intrinsic value. It is the same problem as with Ernst Mayr. You can neither 'disturb' gravitational forces or light rays nor

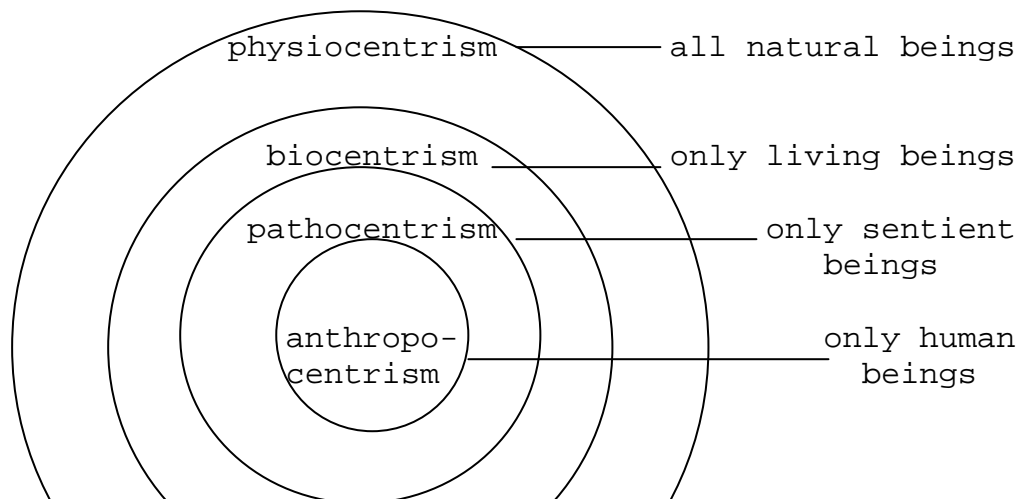
can you speak of their 'right to exist'. The problem is: An exclusive theoretical viewpoint with respect to living beings is impossible. We may fade out morals sometimes, but not forever. Nature is not only something to be computed or manipulated, it is also something and which deserves respect, which is morally relevant. All these problems are dealt within ecological ethics.

In the rest of chapter five, I want to show, that my natural philosophy ($\text{Nat}_{\text{reg/plur}}$) fits well with reasonable positions in ecological ethics. Ecological ethics needs an ontological basis just of the kind I developed above.

6.2 Ecological Ethics and its Ontological Basis

Perhaps the most important problem in ecological ethics is the 'demarcation problem'. Which beings are morally relevant and which are not? Have we to take into account only human beings or animals as well or even plants? Are stones or rivers morally relevant?

First of all, we should distinguish between 'moral agents' and 'moral patients'. 'Moral agents' are only human beings who are reasonable and able to act as free agents. Very young and very old persons are often not or no longer able to act as such free agents, but they are still 'moral patients' in so far, as you ought to have respect for them. Now the 'demarcation problem' deals with the question whether there are non human living beings, who are at the same time 'moral patients'? It is commonly accepted, that we should distinguish at least four positions concerning the 'demarcation problem':



Classical ethics dealt only with human beings as for example Kantian ethics, while the ethics of Schopenhauer was based on compassion. You can be compassionate with every sentient being, with human beings and with animals but not with flowers and trees. So Schopenhauer was a 'pathocentrist'. All these positions differ in scope: What sort of natural beings are 'moral patients'? All of them or only parts of them?

Note that these positions correspond widely to the Aristotelian 'scala naturae': elements, plants, animals, men. This Aristotelian 'scala naturae' constitutes a natural hierarchy of intrinsic values. While in the natural sciences we don't speak of 'values' or even of a 'hierarchy of values', ethics seems to imply such a hierarchy, but only if you reject anthropocentrism.

If you accept anthropocentrism only human beings have an intrinsic value. So, if there are no values in nature, there is no hierarchy of values. But anthropocentrism is linked with $Nat_{reg/scien}$ and with all the difficulties that were mentioned in 1.3. If you accept anthropocentrism, you distinguish sharply between animals and human beings. You can't accept any living beings, who make the transition, as for example chimpanzees. That is why I don't accept anthropocentrism. But there remains still the question, which position is the best one? Patho-, bio- or physiocentrism?

In this lecture, I am only interested in ontological questions and this is why I don't have to decide, which of these positions is best, since they all presuppose an ontological basis of intrinsic values in nature. They all represent the same ontological problem. Only if you think of nature as shot through with values, moral patients become possible. If there are no values in nature, ethical commitments become impossible.

So we can leave open the question 'Who belongs to the ethical club'? Stones as well as plants, plants as well as animals or only 'higher animals' who can suffer and show their interests? It is only requested that the 'ethical club' does not consist exclusively in human beings. If we agree we must concede that there are values in nature, not created by human beings, which is what we concluded as the result of the fourth chapter of this lecture. So, if we accept a reasonable position in ecological ethics, we need just an ontological basis as the one, I developed in this lecture.

But if you read recent books published on ecological ethics, you will find a lack of interest in ontological questions. Most authors accept at the same time $Nat_{reg/szien}$ and a non-anthropomorphic position concerning ecological ethics. Paul Taylor wrote a famous book entitled "Respect for Nature." In this book, he claims that living beings have "inherent worth, based in their very nature." According to him, living beings are a "teleological center of life, pursuing its own good in its own unique way." And then he maintains, that his "entire outlook is firmly rooted in the findings of the physical and biological sciences." But this is certainly false, because if you accept $Nat_{reg/szien}$, you think of a totally neutral nature, devoid of values and ends. But that's just, what you need for such a non-anthropomorphic position. This position presupposes a metaphysics of nature.

Now, today we don't have a metaphysics of nature, which is generally accepted. Quite the contrary! Most authors are scept-

tical regarding metaphysics. But it is clear that both techno-practical reasons and ethico-practical ones lead to a metaphysics of nature.

This explains a very strange phenomenon. There are several very respected philosophers (like Dieter Birnbacher, Günter Patzig, John Passmore and so on), who prefer an austere anthropocentric position. Their position is very counter-intuitive. If you accept this position you must not only contest that there are evolutionary transitions between man and animal, you must also accept, that for instance sentient beings are really moral patients. This means that you must deny that sentient beings have to be respected for their own sake. You can't make an ontological distinction between technological devices and living beings! Everybody, who owns a dog or a cat knows that this is false. From a moral viewpoint, we make a clear cut between computers, cars on the one hand and dogs or cats on the other. Why do very respected philosophers deny this difference?

If you read the books of these philosophers, the reason becomes clear: they know, that you must accept a metaphysics of nature if you deny anthropomorphism and since we have no commonly accepted metaphysics of nature, those philosophers reject non-anthropomorphic positions, suspecting that the ontological basis of those positions are non valid, which is indeed mostly the case. Birnbacher, Patzig or Passmore are right, if they claim, that natural science supplies no ontological basis for non-anthropomorphic positions like Taylors position, and they are right in claiming, that such metaphysical positions like $Nat_{tot/plur}$ make presuppositions which cannot be legitimated. They are aware, that metaphysical concepts like those of Peirce or Whitehead or Meyer-Abich can hardly be justified. So they are forced to accept an anthropomorphic position with all it's contra-intuitive implications. But if we are able to justify a metaphysics of nature, which avoids these extremes, we have an ontological basis for a non-anthropomorphic ecological ethics and we can do justice to our moral intuitions concerning nature and this is, why philosophers like Angelika Krebs, Friedo Ricken or Ludger Honnefelder call for going back to an Aristotelian approach.

So our considerations in chapter four and five yield to the same result: Techno- and ethico-practical reason show us nature as a realm which includes both ends and values.