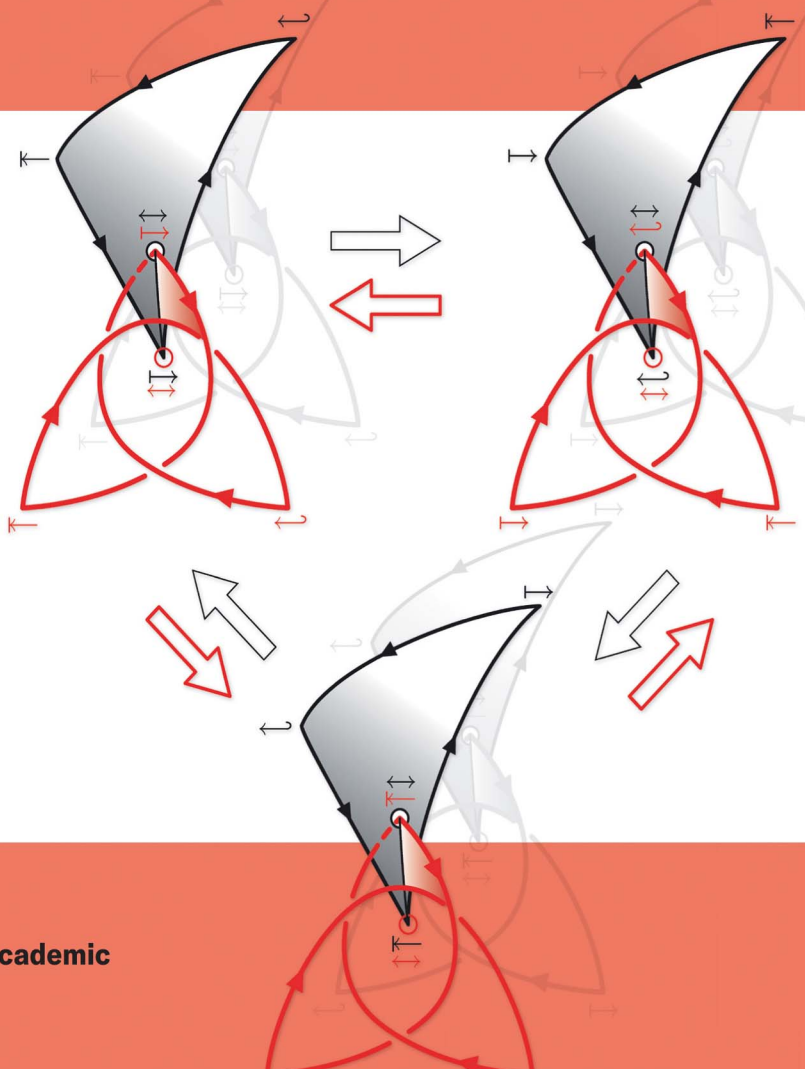
Hans Wehrli

Metaphysics

Chirality as the Basic Principle of Physics



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Preface to the Second Edition 2020

This is a fundamentally revised version of the book's first English edition in 2008 (first German edition 2006).

In order to describe nature as it is observed, a strategy for the development of a physical theory is proposed that circumvents the contradictions between physical observation and mathematical formalism. Six paradigm shifts are required:

1. The laws of nature are as they must be for perception to be possible. The laws are not derived from nature, but from the way nature can be perceived. This way the theory does not simply work. It philosophically explains why it works, even if the formalism of the theory is not yet developed.
2. The theory does without the logical proposition $A \equiv A$, which is replaced by a new axiom of chirality, a prerequisite for any kind of order.
3. The theory does without the axiom of infinity because infinity is not perceivable.
4. The usual entities of space, time, substance (= mass, energy, information) and interaction are replaced by the new, mathematically defined term event, from which all other entities can then be derived.
5. Action without information transfer is non-local and instantaneous, but the information about any change of action travels with light speed.
6. The concept of the black hole is expanded: There are black mini-holes which are stable due to their high symmetry and black mini-holes within black mini-holes with specific action to the outside.

Already in the simple model of a space composed of only four points, terms such as neutrino, speed of light, mass, spin, fermion, boson, Planck's constant and black hole can be represented and the theory of relativity can be unified with quantum theory.

Following the above mentioned *paradigm shift number 1*, the metaphysical prerequisites of any physical theory are described, i. e. the limits of language (Chapter 1), the limits of knowledge and truth in mathe-

matics (e. g. infinity and continuum according to *paradigm shift number 3*) and physics (Chapter 2), the distinction and relation between the ego as subject and nature with its objects (Chapter 3), the role of chirality as the basic principle of any kind of order, be it in thinking, in mathematics or in the perception of nature (Chapter 4), the problem of monism or dualism of body and soul regarding the flow of information from nature to the consciousness of the ego (Chapter 5), and finally the essence of measuring as a counting of events (Chapter 6).

In Chapter 7, a mathematics is developed which is as simple as possible and which does without any axioms that contradict the metaphysical prerequisites. Therefore, the axiom $A \equiv A$ is replaced by a new axiom of chirality according to the *paradigm shift number 2* mentioned above and the continuum with its infinity aspects is dispensed with according to *paradigm shift number 3*. It follows that irrational numbers such as π, e and $\sqrt{2}$ as well as continua are forbidden in mathematical models for physics. The term event is defined mathematically.

Surprisingly the resulting finite mathematics can be interpreted physically (Chapter 8). Space-time consists of single points which produce events by changing their relative configuration without any background space. The simplest such space is the 4-point space which is the model for the neutrino as the simplest physical particle. The counting of the mathematically defined events corresponds to the measurement of space, time, mass and interaction as postulated by *paradigm shift number 4*. According to the new model, actions always are non-local but information transfer between separate systems is always local as postulated by *paradigm shift number 5*.

In chapter 9, it is shown how gravitational interaction can be described as the simplest type of interaction in a many-point universe where action without information transfer is non-local and travels instantaneously according to *paradigm shift number 5*.

Chapter 10 outlines how the mathematical properties of gravitation lead to phenomena such as black holes, time dilation and length contraction of objects by their relative motion as well as by the action of black holes, red shift, deflection of light by gravitation, centrifugal force reversal in the vicinity of a black hole, the Big Bang and inflation of the universe thereafter. The duality of particle and wave and the Heisenberg uncertainty principle can be explained.

Chapter 11 describes electromagnetism by an electron model consisting of 16 points in 4 black mini-holes within a black mini-hole according to *paradigm shift number 6*. It exerts a specific action on the outside that is either attractive or repulsive depending on the arrows of time within these black mini-holes.

In Chapter 12, the concept of black mini-holes is extended to other particles consisting of 16 or more points such as quarks. A few simple rules for their construction and interaction are given. This way also the weak and strong interaction can be described and explained. It is shown how the four types of interaction were developed by symmetry breakings shortly after the Big Bang.

A comparison of the basic ideas and notions of this new chirality theory with other theories is given in chapter 13.

As is the case in all metaphysical and physical theories, there are numerous open questions, e. g. about the experimental verification, the usefulness of the mathematical model, the philosophical foundation of the theory and even about its theological consequences. Such questions are discussed in chapter 14.

Preface to the First Edition 2008

Alles in Allem
Kurt Guggenheim[1]

The question this book poses is: Why are the laws of nature the way they are? My answer is: The laws of nature are the way they have to be, so that perception is possible.[2],[3]

That is the metaphysical answer to a metaphysical question. The hope that natural laws can be deduced in this way from metaphysics motivates me as a scientist to practice metaphysics.[4]

The physical theory outlined in this book has not been fully perfected and is sometimes speculative. Even so, it forms a rounded whole, and as

[1] „Everything in everything". With these three simple words, the writer and physical layman Guggenheim intuitively grasped the essence of modern physics. The words were uttered on the occasion of Albert Einstein's employment interview with the rector of the University of Zurich. The two were in agreement: Physics, everyday urban life and religion: Everything is contained in everything. Nature reveals to us such a governance of laws, such a superior reason, that that which one does, i. e., seek to recognize and grasp these laws, can be designated as nothing other than a service to God [Guggenheim (1952)].

[2] Kant formulated the same thought as follows: There are many laws of nature which we can only know through experience, but the conforming to these laws in conjunction with the appearances, i. e., nature in its totality, we cannot get to know through experience because experience itself requires laws which are *a priori* fundamental to the possibility of it. The possibility of experience at all is thus simultaneously the general law of nature, and the principles of the first are themselves the laws of the latter [Kant (1783/2001) § 36, 39].

[3] He who could, with sufficient intellectual capacity, analyze under which conditions experience is at all possible, would have to be able to show that all general laws of physics already follow from these conditions. The physics thus derivable would be precisely the uniform physics supposed [Weizsäcker (1999), pp. 17 and 344–348].

[4] Einstein (1918) also advocated the view that physicists must derive the laws of nature essentially via deduction from metaphysics and not by induction on an empirical basis.

far as I can see, there are no inconsistencies with any preceding empirical findings in physics. My theory means a paradigm shift for theoretical physics and thanks to this, it can uniformly and simply explain and interlink quite different physical phenomena, phenomena which up until now have been unexplainable or could only be described in separate theories. This is my legitimation for presenting the new theory in its current unfinished state. My basic approach is as follows: As a natural scientist, I am convinced that my consciousness exists and that it generates perception.[5] Other than that, I am convinced of nothing. Then I enquire into the basic philosophical conditions which must be met so that one can speak of perception, for instance, into the separation and connection of the perceiving subject and the object perceived.[6] I attempt to formulate these basic conditions mathematically, whereupon I forgo certain generally usual theorems of logic and axiomatic method. Examples would be the theorem $A \equiv A$ or the axiom of infinity, because they are not suited to the description of perception. Instead, I introduce a new axiom, the „axiom of chirality".[7] The finite mathematics which arises from this is probably akin to a finite group theory or a finite chiral topology. This, however, is not fully spelt out by me; it is a task which must be taken up by others. In any event, the simplicity of the theory is important to me. Yet the simpler a theory is, the more difficult it is to really understand it.

It appears that the resultant theory is nothing other than the basis of all natural laws, the so-called „theory of everything (TOE)". Weizsäcker (1971a, p. 24) considered such a „completion" of physics by derivation from meta-physics possible. Up until now, nature has always been described with the help of the four entities of space, time, substance (I regard the latter as synonymous with matter, energy and information) and

[5] It is difficult, perhaps even impossible, to define the term consciousness. Certainly, it involves subjectivity [Blackmore (2003) pp. 107, 159 and 198].

[6] A definition of the term object is difficult, since objects can never be completely clearly and individually distinguished, because impenetrable borders would make perception impossible. A definition could read: An object is a combination of quantities whose present values permit common predictions about these quantities (in the future) [Drieschner (1981)].

[7] The physical term chirality means handedness and expresses that although the right and the left hand are isometric, they are not properly congruent. That is, one hand cannot be aligned to cover the other.

interaction. All attempts in the last 2500 years to reduce the four entities to three or even fewer have failed so far. According to Plato (1961–1963a), perception always has the character of an event, and the attributes of perception are correlated with the current states of the perceiving humans, so that humans are the measure of all things. Plato tried to reduce physics to geometry, whereby Be-ing in nature is not physical, but rational, and masses and forces are merely psychological appearances which result from the interaction between the observer and the eternal, constant mathematical relations. For Aristotle, the becoming, the event, was real. Einstein tried to completely define space-time with his general theory of relativity with the help of matter. Eddington, on the other hand, sought the opposite; to define matter with the help of space-time [Northrop (1928)]. Also, Einstein, in the 1930s, considered describing elementary particles and space-time as a single entity where the particles would be a kind of knot in space-time [Musser (2004)]. For Descartes, space and matter were synonymous [Weizsäcker (1971b) pp. 9–24]. The most recent attempt to reduce the number of entities is string theory [Smolin (2001)]. In my chirality theory, a new and even more fundamental entity emerges from the axiom of chirality. I call it an event. Space, time, substance and interaction are then all simply different aspects of the event, which I will define mathematically. Whether something is perceived as space or time, as substance or interaction, as fermion or as boson, is relative and depends upon the state of the observer. Even perception itself is an event. According to Whitehead, perception comes about through perception events, a special kind of event. According to his theory, space and time are nothing other than relations between events. Matter is also an attribute of the event [Hampe (1998) pp. 61–73].

Events are countable, so in my theory only whole numbers, that is, values without a physical dimension occur. Resulting from this are the physical constants which are all reducible to the number one, since this is the smallest possible number of perceivable events. The physical constants play a fundamental role in the laws of physics, because they always form a bridge between entities which are completely different physically [Lévy-Leblond (1979)]. The three-dimensionality of apparent space, both theories of relativity and the most important theorems of quantum theory, for example the Heisenberg uncertainty principle, the equation $h\nu = mc^2$, the shortening of standard lengths and the slowing down of clocks at

high velocities and in the vicinity of heavy masses, black holes and the reversal of centrifugal force in their proximity need no introduction. The elementary particles, with their remarkable properties and interactions from the neutrino to the 72 different quarks to the K^0-Meson with its time symmetry violation are derived from the theory. The four known interactions gravitation, electro-magnetism, strong and weak interaction are reconciled and accounted for by the new theory. The Big Bang gains a new significance and the inflation of the universe shortly thereafter becomes plausible. If the reader asks why all this is so, then the answer is ultimately always the same: if it were not so, perception would not be possible.

Central, in my view, are chirality and black holes, phenomena which receive rather little attention in contemporary physics. For example, to my knowledge no physicist has ever asked what happens when a black hole forms within a black hole, and most physicists erroneously believe that the spin has something to do with a direction of motion or with an axis.

The big questions of philosophy have new aspects and in part, answers as well. What is real? What is the difference between a perception and the perceived, between body and soul? New light is shed upon the controversies of Plato/Aristotle [Northrop (1928)], Leibniz/Newton [Leibniz (1715–1716/1990)], Einstein (1935)/Bohr (EPR)[8], Kant/Reidemeister concerning the difference of regions in space [Reidemeister (1957)] or they are harmoniously resolved. In Leonardo da Vinci's world view, space, time and bodies arise from an original movement of Platonic bodies, which is evident in the recurrence of a „symbolic form", the rotating spiral [Arasse (1997)]. Into the place of platonic solids, Leonardo da Vinci's spirals, the modern strings or Pauli's archetypal squares with the two diagonals and his *i*-Ring [Atmanspacher et al. (1995)], now steps the event and its simple mathematical description.

The reader may well ask, how necessary all these associations and digressions in Chapters 1 to 6 really are for the development of a new physical theory which is supposed to be a simple one. Such philosophical excursions may be all very interesting, but what have they got to do with

[8] EPR = Einstein, Podolsky, Rosen-thought experiment in quantum theory [Einstein (1935)].

the actual topic of the book? Yes, I believe that the excursions into theology, philosophy, psychology, biology, and literary history help not only to familiarize oneself with the new physical theory, but also to understand its rationale and nature. All too seldom are physical theories really understood; they are mostly applied because they are useful and because they work. A paradigm shift always calls for a rationale at a meta-level. Thus, a paradigm shift in physics must be accounted for in metaphysics. For this reason, the first half of this book is dedicated to metaphysics.

Chronologically my theory has, in essence, actually been developed as it is presented in this book, beginning with the philosophy of language and the development of a metaphysical approach. The discussion of chirality and measurement processes prompted me to formulate the axiom of chirality. Only then did I begin to concern myself with concrete physical theories and to sketch out a fundamentally new one. If the reader has no interest in understanding this theory, then he can begin by turning straight to Chapter 7. Conversely, a reader who is content to gain a broad appreciation of the theory can pick out what interests him from Chapters 1 to 6, simply take a look at the illustrations in Chapters 7 to 12 and then proceed to the open questions in Chapter 14. Those however, who aspire to truth and clarity, will find resonance in Friedrich Schiller's rendering of Confucius's words:

> Nur die Fülle führt zu Klarheit
> Und im Abgrund wohnt die Wahrheit.[9]

I have tried to make my theory generally understandable and where possible, to cite literature which is intelligible to all. In this way, the literature should serve to inspire, rather than form the actual basis of my theory. At times I have sought to summarize whole books in a few sentences, which are then inevitably not very sophisticated or exact. Without such streamlining however, my book would have become too long-winded and thereby unreadable. Those who wish to know „the fullness that makes us wise" will not escape having to read the books cited for themselves.

[9] „Naught but fullness makes us wise, Burried deep truth e'er lies." Proverbs of Confucius (Bowring's translation). The favorite verse of the physicist and philosopher Niels Bohr [Pauli (1955)].

Who ought to read this book? Every physics and philosophy student can learn something from it. In particular, he will learn to pose questions which are unfortunately not posed by their teachers, let alone answered by them. The book offers mathematicians tantalizing stimulation and I hope that it will give impetus to a mathematics of a Theory of Everything, just as Marcel Grossmann, Hermann Weyl and John von Neumann, together with many other mathematicians, have formulated the mathematics of the theories of relativity and quantum mechanics. Without a new qualitative prior grasp of space-time and its internal transformations, the search for a better mathematical model would become the search for a needle in a haystack [Saller (2003)]. My book delivers this qualitative prior understanding. Every natural scientist is certain to find stimulus in its pages. Those who enjoy interdisciplinary discourse, be they historians, psychologists, engineers or theologians, will also enjoy this book. When the interested lay reader understands three quarters of the book, I will be content. They can take consolation: I have not understood everything either. That is also not all that important. It is far more important that one notices when one has not understood something, for the questions, also those of the reader, are far more important than the answers. And even more important is amazement. Amazement indicates surprise, openness and also a little humility in the face of the amazing things being marvelled at. „Only those who see or experience something unexpected, or those who are able to ignite a sense of the sublime vis-à-vis the marvelous are able to be amazed“ [Janich (2000)].

I would like to thank John Bennett for the careful translation and his persistent efforts to grasp and convey the content and the language of the German original in equal measure. I express my thanks to Heinrich Baggenstos, Philipp Wehrli and Karl Wirth for their critical reading of my book and their numerous suggestions. My wife Christel has accompanied the formation of the present theory in countless conversations over the last 35 years and with her clever questions, stimulated me to ever new considerations and explanations.

The Tao[10],[11] that can be told is not the eternal Tao.
The name that can be named is not the eternal name.
The nameless is the beginning of heaven and earth.
The named is but the mother.

Therefore: He who looks calmly inward,
Experiences the wonder of unlimited being.
He who wishes to possess the world and holds onto names
Finds mundane limitation.

In origin these two are one, differing only in name.
Beyond comprehension is this unity.
The secret of secrets,
The gateway to the revelation of everything.
Lao Tse (ca. 600 BC/1978)

[10] Chinese „Tao" means way, path, course of nature, which underlies all appearances, the knowledge of which remains beyond comprehension, however. Tao is also often translated as sense [Wilhelm (1978)].
„Those who understand the sense (Tao), understand the laws of nature" writes Dschuang Dsi (ca. 340 BC/1972) p. 195.

[11] Dschuang Dsi, a contemporary of Plato, said this about the psychological precondition of the Tao (sense): „The state, where I and not-I (i. e., subject and object) no longer form a contrast." The distinction between subject and object only comes from the subjective viewpoint [Jung (1967) (pp. 542 ff.)].

Chapter 1

The Limits of Language

Language is the house of Be-ing[12]
Martin Heidegger (1946)

Writing a book, be it about philosophy or natural science, requires language. Even simply thinking about such things is not possible without language.[13] The philosopher and the natural scientist should therefore be aware of what language can and cannot do. All too easily a physicist can be led to believe that he has found a natural law, whereas a careful analysis reveals that his „law" is simply a consequence of the language used. The primary language of physics is mathematics, an abstract, strictly formalized and relatively precise language, which easily misleads the speaker about how inaccurate or even paradoxical his propositions are. Philosophers on the other hand are more concerned than physicists with the central significance of language. There are even those who simply define philosophy as the universal criticism of language and meaning [Heintel (1988)]. A language is a system of signs serving to convey information. The signs are signals that we are able to perceive with our senses, i. e., gestures, sounds, images, symbols or scripts. The signs or characters and words, are positioned in a particular relation to each other. In other

[12] Die Sprache ist das Haus des Seins.

[13] Thinking is more, and more complicated, than simply having a consciousness. For consciousness alone, humans do not yet require language. Einstein wrote: „The words or the language … do not seem to play any role in my mechanism of thought. The psychical entities which seem to serve as elements of thought are certain signs and more or less clear images which can be „voluntarily" reproduced and combined … The abovementioned elements are, in my case, of visual and some muscular type. Conventional words or other signs have to be sought for laboriously only in a second stage, when the mentioned associative play is sufficiently established and can be reproduced at will." [Penrose (1989) pp. 383 f., 423].

words, language has a structure. The signs themselves, as well as their relative arrangement, all have a meaning about which all the living creatures communicating with each other should be in agreement, lest misunderstandings arise. So, language needs not only to be conveyed, e. g., from a radio transmitter to a receiver, but needs also to be understood. For this, a receiver capable of understanding is necessary.

Accordingly, linguistics (or semiotics) is concerned with three relationships: firstly with the relationship of linguistic signs to each other, called syntax; secondly with the relationship between linguistics signs and the designated objects, called semantics; and thirdly with the relationship of language to speaker and listener, called pragmatics [Hinzen (2017)]. In the following we shall have a closer look at these three types of relationships.

1.1 Language and order

Irrespective of the kinds of signs composing a language, they always stand in a temporal or spatial relationship to each other. This applies even when the language is neither written nor spoken, but merely thought. A chaotic arrangement of characters or sounds would contain no semantic information and cannot be a language. A written text is ordered in space. When the text is read, it is ordered in time. Both language forms have, apart from script and sound characteristics, the same information content. This is familiar to us and has become completely self-evident. It is, however, a phenomenon which becomes all the more amazing, the longer one reflects upon it. Amazing in itself is the fact that a three-dimensional arrangement such as space can apparently be easily represented in a one-dimensional order such as time, without any significant loss of information. This gives us a first hint of a certain analogy between three-dimensional space and one-dimensional time. Moreover, this raises the following question: What are the structural interrelationships between language, time and space? Are their similarities coincidental, do they have a common basis or is one a consequence of the other? If philosophy does not exist without language, and if philosophy is, in a certain respect language criticism, could there even be philosophy without time or space? Answering the latter in the negative raises the question as to how

free philosophers actually are when they philosophize *in* space and time *about* space and time. We can state: Language requires a certain framework and for its part, it sets boundaries.

1.2 Meaning

Scientists are used to explaining the meaning of a word with a definition, which in turn is made up of other words. Defining is an endless process, for which more and more new words are required. After all, in the ever-lengthening chain of definitions words appear which we have already met, perhaps in another context. Thus, we have already had the occasion to consider the meaning of these words. Complicating matters is the fact that most words have several different meanings and that they can stand for a concrete individual here and now, or for a whole class of things. „The dog" could be my dog Barri, or an abstract class of elements, which all have a certain number of dog-like attributes. Even a toy dog is a dog. In the first case the dog is an individual, in the second an idea. However, the dog can also be something quite different, e. g., a constellation of stars. Moreover, there are different words for one and the same object, all meaning the same, e. g., „chien" or „Hund" or „собака". Incidentally, there is nothing to prevent me from writing as of now „blabla" or „MÜ MÜ" instead of „dog". In light of all this, can language be precise at all?

Let us take an example from mathematics, an exact science. How, for instance, can one define the term „point"? „A point is an infinitesimal place in space" could be one definition, or „A point is a thing whose only core attribute is that it exists". These are quite sophisticated definitions and one could discuss them for hours without becoming any wiser. After all, every child knows what a point is. The relationship between the word „point" and the speaker or hearer of this word, i. e., the child, will be discussed in the next section. For now, we are looking for a definition of „point" which is valid, whether it is communicated or not. For this we have used words such as „space", „place", „is", „exists" and „infinitesimal", words which are themselves not easy to define. Space could be defined as the sum of all points and place as the sum of neighboring points. In so doing, we see immediately that the definition goes in a circle: „point" is defined with the help of „space" and „space" is defined with the help of

„point". Such circular definitions are unavoidable, even in strictly formulated logic. It is clear, that in the same way, no language can be constructed precisely. Language is thus fundamentally imprecise from a scientific point of view, i. e., we can never know precisely what a text means. Here, also, language has limitations [Weizsäcker (1972)]. Nevertheless, there are a few important terms, as they are to be understood in this work, which should be defined.

Physics describes observed nature and formulates by means of mathematical methods laws of nature, which permit predictions (about the future). *Nature* is the entirety of all those things which can, in principle, be empirically – directly or indirectly – perceived (Whitehead 1925/1939). In this sense, nature is *real* or *material*. *Existence* in chirality theory is an ontological property of anything that is either real or – if not real – must have a Be-ing in nature. For example, a point or a natural number is not real but it exists. A boson is directly, a fermion indirectly perceivable; therefore, both are real. Also, black holes can be indirectly observed and are real. Space and time *per se*, all numbers except the natural numbers, and infinity are neither existing nor real but only ideas or mathematical models. The examples mentioned for this definition of reality and existence will be discussed later in the book. I am aware that depending on the philosophical and epistemological point of view there might be other definitions. *Mathematics* studies patterns in abstraction of the individual things which are patterned (Hampe 1998). *Empirical perception* is a flow of information from the outside into the conscious mind of a subject. The subject is an entity, which can take up, store and consciously process information. If the observer is transcendental, he is called a *presumed observer* and he is not part of reality. It is left open as to whether a subject can itself be part of nature. For the considerations in the present work it is sufficient to proceed from only one subject, the *ego* [Descartes (1641/1960) 1 (18–19), 16 and 2 (26–27), 23]. Possible further subjects and intersubjective communication are not brought up for discussion, because such further subjects can never be unequivocally differentiated from objects. An *object* is a summary of mathematical quantities or patterns, whose current values permit predictions about these very values (in the future) [Drieschner (1981)]. *Information* can be defined as answers to potential questions which can be reduced to a countable number of so-called *binary choices*, i. e. to alternatives which can be

decided with a simple yes/no answer. The binary choices are computable as bits or qubits [Weizsäcker (1986), pp. 163–173].

We shall now examine the extent to which today's usual methods and terms of physics contradict the definitions above. Subsequently, those basic metaphysical conditions for a physics which conforms better to these definitions are to be described.

1.3 Understanding

If the reader has not given up so far, he is probably confident that he has understood at least part of the text and that, by and large, the author has the same understanding. This is by no means self-evident, considering all we have just discussed about the limitations of language. On what then, do we base the belief that despite occasional misunderstandings, we actually understand each other quite well? In order to answer this question, it is helpful to examine how a child learns to understand something.

Even prior to birth, a child receives stimuli. The sense of touch reveals spatial boundaries, the baby becomes accustomed to the constant comfortable temperature or it hears sounds. The child receives these stimuli unconsciously, though perhaps also with an increasing consciousness. I am reasonably certain that even today I can still recall that comfortable, simple and orderly pre-birth feeling, although it would of course be impossible for me to name a concrete event. There is no question of a language at this early stage of development, not even a primitive one. However, experiences are already taking place, in which information is transmitted, processed and stored as memory. In this way, the first foundations of a later language are laid.

After birth, the number of stimuli increases at a bewildering rate. The infant begins to compare certain perceptional experiences with his still unconscious memory and relies at first on the relatively simple experiences of taste, smell and hunger. Between perception and memory an order begins to crystallize, which is always ordered in time, since the memory precedes the perception with which it is being compared. It can remain open here as to whether the order is established solely in the brain or in a transcendental consciousness as well. It is equally irrelevant whether the perception is sensual, psychic or mental in nature. Of sole

importance is that the order is chronological and that the infant develops a sense of time, albeit a rudimentary one, quite early.

Next come the light bulb moments of „if – then“: If I cry (or more precisely: if there is crying), then the mother will come. Even if this does not always work right away, the infant will unconsciously recognize that there is such a thing as cause and effect. That he, as an independent being can himself be a cause, is outside the infant's awareness in the beginning. He is not yet capable of distinguishing between I and you. However, his sense of order and time develops, since the cause always precedes the effect. The child learns that it is often worthwhile to differentiate between the signals perceived and to store them in his memory.

The visual sense, sight, develops more slowly. This is primarily because sight is more complicated than all the other senses. The child must learn on the one hand how to reproduce a three-dimensional space in the brain via a two-dimensional visual field, on the other hand to simultaneously distinguish between colours, light and dark, and left and right. That is difficult and takes years. That said, we now know from experiments carried out with small children, the theory that language is a precondition of spatial perception is wrong. Most children are able to manage spatial perception, at least the perception of topological arrangements, before they start speaking [Piaget (1970)].

Thus, the four conditions necessary for understanding a simple language are met:

- An initial speech signal can be received.
- The information of the signal is stored and is associated with the context of the experience or stream of experience in which the signal is received.
- The stored information or memory can be compared with the new perceptions, i. e., with newly received signals as well.
- Should this comparison reveal that the new signal is similar to the first signal, the child will then associate the new signal with the experiential context of the first signal. If the child does not err in doing so, it will have understood the second signal.

Communication is not dependent on the capacity to understand language alone. Equally important is that the language expresses what the speaker wants to say. The mechanism by which this occurs is, in prin-

ciple, the mirror image of the mechanism of understanding described above:

- The child has a psychic or mental experience in his brain or consciousness.
- The child compares this experience with images of memorized earlier experiences and looks for a similar one.
- The child associates the earlier image with its signal.
- The child sends an appropriate speech signal.

This reverse process is more difficult for the child to learn than the receiving and understanding of signals, so it takes quite some time before children learn to differentiate in their speech in the way they do in understanding what they hear. The ability to understand a language is not limited to humans. In principle, animals are able to do so as well. Some animals are better equipped to receive certain signals than humans and have superior memories. However, in associating different signals with different contexts of experience, human beings surpass all animals.

What about computers? Are computers only able to receive, store and process, or can they understand as well? Understanding requires a stream of experience, which is more than the registration of stimuli. Of course, a computer is also able to connect the word „red" with the wavelength of the colour red. Even so, it will not experience the sensation of red in the way humans do when they see red, hear the word „red" or visualize red. (Some humans can even *smell* red!) It may well be possible, in principle, to program such a sensation, however this will always be completely different for a computer from how it is for a human, since being a machine it can never have precisely the same experience and store it in a stream of experience as humans can. Thus, the computer cannot understand humans, mainly because it is not human itself. Since animals are also not human, they will also – independent of their limited mental potential – only ever partly understand a human being.

Ultimately, this also applies to different human beings. Each person lives in its own stream of experience and accordingly, understands language as an individual and differently from everyone else. Ask for instance ten different people what „God" means and you will receive ten different answers, although „God" is a pretty familiar concept, about which most children have to learn quite a lot. God is the father in heaven,