1

The Absolute Truth

1.1. Final Truth

Can the progress in science, in particular in physics, lead to a final truth of the physical world? In other words, can we discover a complete theory about the cosmos? Are humans able to grasp all the features of the universe? It has often been suggested that this should be possible and, furthermore, it has also often been pointed out that such an absolute truth will be available soon. For example, Stephen Hawking suggested in his famous book *A Brief History of Time* that we should thoroughly be able to discover such a complete theory and also to find out "*why it is why we and the universe exist. If we find the answer to that, it would be the ultimate triumph of human reason — for then we would know the mind of God.*" [1]

The superstring theory is often considered as the final, complete theory of nature. The fundamental point is that here the basic building blocks of nature are not point-like particles, as usually assumed in conventional elementary particle physics, but one-dimensional very short vibrating strings (and other objects: vibrating two-dimensional membranes, three-dimensional blobs and other ingredients). This superstring theory is also known as "Theory of Everything" since the scientific community firmly assumes that this theory is that what we have called above "absolute truth", that is, it is believed that the superstring theory is a complete framework for the explanation of every fundamental feature in the universe.

John Horgan discussed in his book *The End of Science* the situation in superstring theory with Edward Witten, who coined the term superstring theory. In this connection Horgan wrote [2]: "… *acknowledged, even emphasized, that no one had truly fathomed the theory, and that*

it might be decades before it yielded a precise description of nature. He would not predict, as others had, that superstring theory might bring about the end of physics. Nevertheless, he was serenely confident that it would eventually yield a profound new understanding of reality." There is obviously no doubt for Edward Witten that the superstring concept describes the basic and final structure of the cosmos: "Good wrong ideas are extremely scarce … and good wrong ideas that even remotely rival the majesty of string theory have never been seen." In other words, in the opinion of Witten the superstring concept is too elegant and beautiful to be wrong. But Witten still goes a step further: He is convinced that superstring theory could be discovered by any other advanced civilisations in the universe, that is, independent of any specific culture or biological structure of the observers.

1.2. Two Important Questions

In connection with Stephen Hawking's and Edwards Witten's statements and thoughts, respectively, we are concerned with the following important question: How general can a human observer formulate the laws of nature? There are two points of particular relevance:

1. Can a human observer actually formulate the laws of nature independent of his own nature, that is, independent of his biological structure?
2. Can we really find out "why" we and the cosmos exist?

These questions are of central relevance, and they contain secrets of cosmic extent. In this monograph we would like to discuss the essential points in connection with that, what we can know about the universe and what we do not.

1.3. Why Does the Cosmos Exist?

In connection with Stephen Hawking's statement "… why we and the universe exists" we have critically to ask the following question: Do the physicists really develop new theories that describe *why* the cosmos exists? Here we have to be careful. No, it is the rule that they do not.

The physical theories describe *how* certain systems work not *why* they work. Modern physical sciences started with Newton's gravitational theory and, as is well known, this theory allows, for example, for us to determine the precise motion of a planet around the sun. Newton's laws tell us *how* the planet moves but gives no explanation of the machinery of gravitation, that is, *why* a planet moves around the sun. "*Newton was originally asked about his theory* — 'But it does not mean anything — it does not tell us anything'. *He said, 'It tells you how it moves. That should be enough. I have told you how it moves, not why'.* [3]

What can we say about basic quantum theory that governs contemporary physics? Do the basic laws of quantum mechanics tell us *why* nature is organized in the way as it is? Here we also have to answer the question of how does it work. What machinery is actually producing these quantum effects? Also here we would like to argue as follows: If we know this machinery, we also know why nature is organized in the way as it is. Can we formulate a basic mechanism (or more than one) that explains quantum phenomena? This question can clearly be answered. Let us give here only some principal remarks:

The understanding in terms of mechanisms or models most often assumes understanding effects on the basis of mechanisms that we observe in everyday life. This is however not possible in the case of quantum mechanics and must be excluded. The modern interpretation of this theory does even not allow us to invent more complex mechanisms that are beyond the usual pictures and mechanisms observed in everyday life. The reason why is that in quantum theory the particle (for example, an electron) motion cannot be analyzed in terms of a continuous motion; we can only say something about probabilities. Here probability is not a mean of approximation, but probability is obviously established at the fundamental scientific level. "*It is not our ignorance of the internal gears, of the internal complications, that makes nature appear to have probability in it. It seems to be somehow intrinsic. Someone has said it this way — Nature herself does not even know which way the electron is going to go.*" [3]

We know the laws of quantum theory but we cannot understand them in the sense that we can analyze them in terms of (intimate)

mechanisms and, therefore, if probability is an intrinsic feature of nature we will never know *why* all these things and effects are as they are. (That does not mean that the present quantum laws must represent the final truth in connection with quantum theory.)

In conclusion, as in the case of Newton's gravitational law also quantum mechanics only tells us *how* quantum systems behave, but not *why*. Also within string theory the basic laws of quantum theory are assumed to be valid.

The discussion above has been exclusively based on theoretical physical arguments. Since physics represents that which we call "basic science" we probably never find out at this level *why* we and the universe exist. Clearly, philosophical considerations can help to deepen our knowledge about the universe but philosophical arguments are very often not based on "hard" facts, namely those which are accessible to empirical tests.

1.4. Are the Laws of Nature Independent of the Observer's Own Nature?

As we have outlined above, Edward Witten is obviously convinced that the theoretical structures given by superstring theory are quite general and should therefore reflect that which we have called "absolute truth". In particular, Witten is convinced that superstring theory could be discovered by any other advanced civilizations in the cosmos and should therefore be independent of the structure of the individuals forming a certain civilization, that is, the outer shape and the material structure of the brain of the various individuals could in principle be quite different from those of the human observer.

Is such a view realistic? Can the laws of nature be independent of the observers own nature? It is not, as we will recognize below.

From our interaction with the outside world we obtain information about it. We can only say something about a complete theory (about the final truth of the physical world) if this information covers all possible aspects of the universe. Is a human observer really in the position to interact with the outside world in a way that he is able to pick up all aspects of the universe? Is that possible at all? Here we must say that

he is definitely not able to. This point will be discussed in more detail in the forthcoming chapters too.

In connection with all these points, the following general question is relevant. How does science proceed? Is there anything like a "final view" of the things? Which tendencies exist historically to categorize a status of knowledge acquired? Let us briefly mention some of the most relevant opinions.

1.5. Self-Indulgence was Dominant

Not only Hawking and Witten believe that the present theoretical structures of the physical laws represent the final (absolute) truth, but scientists of all epochs thought that the scientific laws "now" approached their final state of completion, i.e., scientists of all epochs were convinced to have the absolute truth in their hands. However, every time it turned out that this belief was a fallacy. It is a certain kind of self-indulgence.

For instance, Lord Kelvin (1824–1907) thought that the foundations of physics as laid down towards the end of the last century were complete and that only secondary questions were still left to be answered. Berthelot (1827–1907) in 1885 felt that their world no longer concealed any secrets. Haeckel (1834–1919) concluded from his studies (also made towards the end of the 19th century) that all legitimate questions in natural science had essentially been answered. Another example of this tendency is given by Max Planck (1859–1947) [4]:

> *"As I was beginning to study physics (in 1875) and sought advice regarding the conditions an prospects of my studies from my eminent teacher Philipp von Jolly, he depicted physics as a highly developed and virtually full-grown science, which — since the discovery of the principle of the conservation of energy had in a certain sense put the keystone in place — would soon assume its final stable form. Perhaps in this or that corner there would still be some minor detail to check out and coordinate, but the system as a whole stood relatively secure, and theoretical physics was markedly*

approaching that the degree of completeness which geometry, for example, had already achieved for hundreds of years. Fifty years ago (as of 1824) this was the view of a physicist who stood at the pinnacle of the times."

If we jump from the last century to the present, we find a recurrence of the opinions above. For instance, Richard Feynman wrote [4]:

"What of the future of this adventure? What will happen ultimately? We are going along guessing the laws; how many laws are we going to have to guess? I do not know. Some of my colleagues say that this fundamental aspect of our science will go on, but I think there will certainly not be perpetual novelty, say for a thousand years. This thing cannot keep on going so that we are always going to discover more and more new laws … We are very lucky to live in an age in which we are still making discoveries. It is like the discovery of America — you only discover it once. The age in which we live is the age in which we are discovering the fundamental laws of nature, and that day will never come again. It is very exciting, it is marvellous, but this excitement will have to go. Of course in the future there will be other interests … There will be a degeneration of ideas, just like the degeneration that great explorers feel is occurring when tourist begin moving in on a territory. In this (present) age people are (perhaps for the last time?) experiencing a delight, the tremendous delight that you get when you guess how nature will work in a situation never seen before."

It is clearly evident from all the examples cited that eminent personalities (and obviously not only these) in different epochs thought that scientific findings "now" approached their final state of completion. Evidently, there have also been epochs in which the knowledge available was judged with less self-indulgence: Nicholas Rescher in his book entitled, "The limits of Science" [4], from which most of the texts of the examples quoted above have been taken, deals with these anti-positions. However, compared with the discussions in present day literature, the opinions of the authors quoted before — especially those

expressed by Hawking, Witten and Feynman — seem to dominate for the time being. However, the past showed that this belief was every time a fallacy and only a certain kind of self-indulgence remained.

The facts from the theory of science have taught us that we will never be able to make final and complete statements about the physical universe, i.e., from the point of view of theory of science the "absolute truth" can never be obtained. This is an important statement and will be justified below.

1.6. Newton's Mechanics and Its Overestimation

As we have outlined above, scientists of all epochs thought that they have the "absolute truth" in their hands. In other words, they were firmly convinced that the scientific laws "now" approached their final state of completion. However, it was every time a mistake. A typical example for such a delusion is given by the far-reaching conclusion which was drawn from Newton's mechanics. Let us briefly discuss the background of this undesirable development.

1.6.1. *Instead of Gods, Capricious Fairies etc. We Have the Equations of Motion*

Before Newton one throughout believed, that the events in field and forest, and of course in heaven, would be influenced decisively by gods, demigods, capricious fairies and other mystical phenomena. This situation changed fundamentally with Newton's new point of view: Newton could state something about the movement of celestial objects without striving gods or capricious fairies. Within the frame of Newton's analysis phenomena in heaven cannot be caused by mystical individuals.

The essential point is that Newton's equations of motion describe the motion of the celestial bodies completely. Besides the gravitation introduced by Newton there are no other influences; in particular, there are no gods, demigods or capricious fairies. The calculations agree with the observations in such a precise way, that it would be absurd to assume that in the motion of the celestial bodies any other elements would be

effective — others than those which belong to Newton's equations of motion.

Therefore, the direct experience agrees with the statements of the theory. Capricious fairies do not appear there, and they do not influence the motion of the celestial object arbitrarily, nothing like that, no tremble, no swerve, which would not be under mathematical control. Only the gravitation in the sense of Newton is effective. In other words, Newton's theory eliminates all the gods, capricious fairies, etc.

With Newton's theory people believed to hold the truth in their hands. In its extreme form of application one even believed to hold the truth about man, the truth about life in the hands. In the application of Newton's theory scientists did by no means restrict themselves to appropriate problems, not at all, because also man and life with all its complexity, i.e., with all his bodily, mental and emotional conditions have been considered as a Newtonian system. This appears, however, not appropriate. The reason is easy to recognize and is given by the basic characteristics of Newton's theory.

Within the framework of Newton's world view everything is given by the equations of motion, and these equations have the characteristic that, if one knows the state of a system at a certain time, the states for all future times are exactly determined, that is, man appears here as a certain kind of mechanical machine without spontaneity and creativity. This is certainly an absurd picture of man and is based on the success of Newton's mechanics, and due to this success the laws given by Newtonian theory were seen as the basic laws of nature, and classical mechanics was considered to be the ultimate theory of natural phenomena. In other words, scientists believed to have the "final (absolute) truth" in their hands.

1.6.2. *Lamettrie and the Monistic Picture of Man*

It was Lamettrie who required that, in addition, living human bodies (and of course animals and plants) should behave like a machine, i.e., without any spontaneity; in Lamettrie's opinion, the behavior of men

was also completely causal and determinate. In other words, it was seen as being possible to predict — in principle — with absolute certainty all the future activities of a man if his present state was known. Within this picture of reality men are merely automata and not free individuals capable of influencing the course of events by their volitions; the world is completely mechanistic in its ultimate nature, and the mind is a production of mechanics. Clearly, all those conclusions about men which were based on religious considerations had no place within such a picture.

The Cartesian division

The ideas of Newton (1643–1727) and Lamettrie (1709–1751) were influenced by the philosophy of Descartes (1596–1650). Descartes developed the spirit/matter dualism very extensively. He maintained that mind and matter are divided into two separate and independent realms, i.e., the mind should have no contact with matter and vice versa. Mind and matter had entirely different functions to perform: mind to think and matter to occupy space.

Descartes' fundamental division allowed one to treat matter as dead and completely separate from men, and to see the material world as an ensemble of different objects which form a huge machine. Newton constructed his mechanics on the basis of this mechanistic world view. The philosophy of Descartes has had a considerable influence on the general western way of thinking up to the present day.

The Cartesian division guarantees an objective description of the world. On the other hand, the division of mind and matter into two separate and independent realms created a serious problem: if man's will (which can be considered as a result of an operation of the mind) has no contact with the matter of his body, how can it compel this body to turn to the right or to the left as it pleases?

According to Descartes the spirit/matter dualism exists only for men but not for living animals, plants, etc., which was seen as objects without mind, i.e., their behavior was assumed to be completely causal and determinate like to a huge mechanical machine working in accordance with Newton's mechanics. In other words, Descartes

assumed for animals, plants, etc. a monistic picture and for men a dualistic one.

However, Descartes world view seems too artificial, and a uniform picture should be the goal. Such a uniform conception of reality was formulated by Lamettrie, who claimed that the monistic picture for animals, etc. is also valid for men. Lamettrie's world view requires that feelings, free will, etc. are effects produced by a complex mechanical system (the human body). Within such a framework, based on Newton's mechanics, all the future feelings, etc., can in principle be predicted if the man's present mechanical state is known. Within Lamettrie's world view all subjective elements are eliminated.

The influence of Darwin's evolution theory

Lamettrie's radical form of materialistic natural philosophy received little attention in the eighteenth and the first half of the nineteenth century. However, the concept of an evolving world rather than a static one changed the situation. Darwin (1809–1882) proposed in the second half of the nineteenth century that the earth and all living things had evolved through a long history, a history of continual, gradual change. This concept of an evolving world, however, is in contrast to the creation myth of primitive people and of most religions, which have a common, essentially static concept of a world that, once created, has not changed. Darwin's evolution theory was almost universally accepted by serious scientists even before his death in 1882, and the following view became more and more popular: No God had created the earth and everything on it at a certain instant, but all these things had evolved throughout a long history in line with the laws of physics, which were assumed to be Newton's equations of motion.

This view was the reason why Lamettrie's radical form of materialistic natural philosophy became increasingly attractive. For example, within the framework of Haeckel's (1834–1919) monism these tendencies are clearly reflected; there were many editions of his monograph *Die Welträtsel* [5] and it has been translated into more than 25 languages. Haeckel's materialistic world view has had a considerable echo up to the present day.

1.6.3. *Conclusion*

Again, with Newton's theory scientists believed to hold the "absolute truth" in their hands. We know that this belief was a fallacy; new theoretical developments (the Theory of Relativity and quantum theory) disproved the assumption made to consider Newton's mechanics as "absolute truth"; on particular, Lamettrie's radical form of materialistic natural philosophy with man as mechanical machine became outdated.

However, the conviction to soon have the "absolute (final) truth" on the table is also believed today in connection with newer theories, which are based on the Theory of Relativity and quantum theory. Many books suggest directly or at least unequivocally, that we will know "God's strategy" soon, that is, the "absolute truth"; with only a few minor steps and everything is known. But here also there are relevant objections against these newer tendencies for the assumption that the final formulation of the physical laws is (almost) to be reached.

There are principal reasons that speak against this assumption. In this connection two points are of particular relevance: (1) The phenomenon of evolution. (2) Basic statements of the theory of science. Before we explain these points in more detail, let us investigate whether Newton's equations of motion describe processes in the absolute reality. We already know that these equations cannot reflect the final, absolute truth, but they could in principle be part of the absolute truth, i.e., an approximate representation of it in absolute (basic) reality.

1.7. Scientific Realism

Which kind of truth is ultimately described by theoretical physics? Is physics actually in the position to describe that which we have called "absolute truth"? Let us explain this point by means of Newton's equations of motion.

Let us study the situation by means of an example, namely the earth at its motion around the sun. Earth and sun interact, i.e., they

attract each other, and for this attraction Newton could formulate a mathematical relation. Furthermore, if we know the position and the velocity of the earth at a certain but arbitrary time, then the movement of the earth around the sun is determined for all times τ, at least in principle. One knows, in other words, at which position in space the earth will be in the year 2020 or where it was, for instance, in the year 1900. In order to calculate these data, we only have to solve the right equation, which is quite simple in its structure and has the following form: $m_E(d^2\mathbf{r}_\mathrm{E}/d\tau^2) = -Gm_E m_S(\mathbf{r}_E - \mathbf{r}_S)/|\mathbf{r}_E - \mathbf{r}_S|^3$, where $\mathbf{r}_E$ and $\mathbf{r}_S$ are the position vectors of earth and sun, m_E and m_S are their masses, and G is the gravitation constant. More elements are not involved in the equation of motion. All the other details in connection with this equation are not of interest for our discussion. Newton's equation of motion describes the path of a celestial object under the influence of another celestial object, here the path of the earth within the gravitation field of the sun.

Let us assume that the above equation describes the absolute reality. Then, we have to consider the masses m_E, m_S and the gravitational influence between them as really existing in the reality outside. To imagine this, first of all gives us no problem. Also the solutions of Newton's equation of motion (it is a differential equation) have to be considered as really existing, that is, the possible paths of the mass reflect the deepest ground of reality. This assumption too gives us no problems since we actually observe the movements of the celestial objects; we have them directly in front of us. Therefore, we can assume at the outset that these paths also reflect an absolute fact.

Up to this point one can pre-suppose, that the equations of motion with all their elements and solutions reflect the structure of absolute reality and, therefore, actually describe what we have called "absolute truth". In other words, reality at the deepest ground is structured as is formulated by physics.

But we have to be careful, because such a kind of scientific realism would consequently mean that the celestial objects would continuously solve differential equations in their movements through space, since Newton's equations of motion are differential equations, as already mentioned above.

Such an idea must however be considered as absurd. Where is the computer hidden which would do this work? Who does this work with lightning speed and simultaneously everywhere? By the way, the mechanism with which nature solves the differential equations would have to be delivered by the theory itself; in other words, it should be the content of the theory; this is however not the case.

Such a scientific scenario (realism), that the masses solve in their motion through space incessantly differential equations, has to be excluded and must be judged as ridiculous, which is also reflected in the following remark [4]:

> *"As Herschel ruminated long ago, particles moving in mutual gravitational interaction are, as we human investigators see it forever solving differential equations which, if written out in full, might circle the earth."*

This brief analysis makes clear that we affect with Newton's ideas by no means that what we have called "absolute reality" and "absolute truth", respectively, and that is true for all theoretical developments in physics, even for the newer theoretical developments, because everything in natural science is formulated in accordance with Newton's basic way of thinking, for which is characteristic, that the scientific laws are formed on the basis of what is directly in front of the observer. Nicholas Rescher, distinguished epistemologist, expressed this fact by [4]:

> *"Scientific realism is the doctrine that science describes the real world: that the world actually is as science takes it to be, and that its furnishings are as science envisages them to be.... It is quite clear that it is not ..."*

The facts (the paths and the physical elements and effects tied with them), which are described by the above introduced equation $m_E(d^2\mathbf{r}_E/d\tau^2) = -Gm_E m_S(\mathbf{r}_E - \mathbf{r}_S)/|\mathbf{r}_E - \mathbf{r}_S|^3$ only represent a certain kind of truth but cannot be considered as absolute in character. If we accept that (there is obviously no other possibility for that), the consequences are significant for everything which appears directly in front of us: If everything, which is described by the equation of

motion $m_E(d^2\mathbf{r}_E/d\tau^2) = -Gm_E m_S(\mathbf{r}_E - \mathbf{r}_S)/|\mathbf{r}_E - \mathbf{r}_S|^3$ (the path of the celestial object, which we have in exactly this form directly in front of us) cannot be the last, absolute truth, then also all the other things, which are in front of us and which we feel by our sense of touch, cannot be the last, absolute truth too. This, of course, is also true for that what we perceive of ourselves and other creatures. This result is of fundamental meaning.

In conclusion, the equations of motion cannot be the last, absolute truth. Since the derivation of these equations have been directly based on that which we have in everyday life in front of us, these optical impressions cannot also be part of an absolute (basic) reality. Thus, a human observer is not able to recognize the absolute truth, that is, the deepest ground of reality. The situation is summarized in Fig. 1.1.

What kind of reality could be involved when we base our descriptions on the equations of motion? Do the impressions that we have directly in front us actually reflect a certain kind of reality at all or is it "only" a symbolic picture of it? When we base our considerations on the usual assumption that everything is embedded in space and time, then we may assume that the impressions in front of us directly reflect a real situation with material objects, i.e., it may not be "basic realty" (see the remarks above in connection with the equations of motion), but it is a certain kind of reality, namely that which is given by material objects, which are embedded in space and time. However, we will recognize below that this should not be the case. It will turn out that it is more realistic to assume that our direct optical impressions are "pictures of reality" but not reality itself, that is, that the objects in space and time are geometrical figures and are not material objects.

1.8. An Important Principle: As Little Outside World as Possible

We came to the conclusion that a human observer is not able to grasp the "absolute truth". What we have in front of us in everyday life is obviously not basic reality or absolute truth. Nevertheless, this experienced world could contain the complete information of the

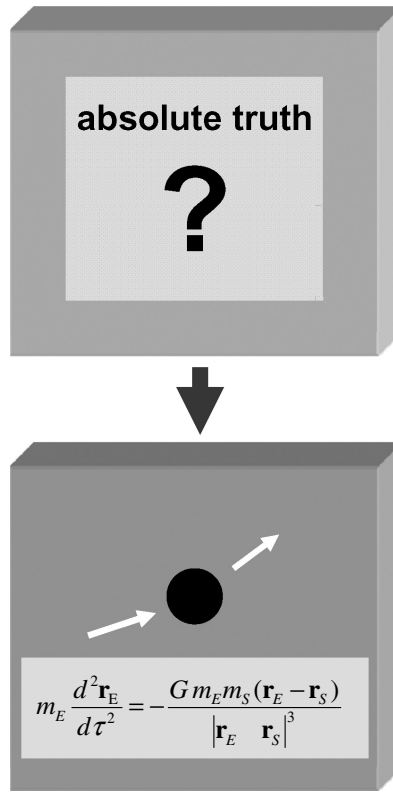

Fig. 1.1. Newton's equations of motion cannot be instruments for the description of the absolute (basic) truth. In particular, we have ascertained that it is hardly realistic to assume that celestial bodies solve differential equations during their motion.

universe, at least in principle. Since the experienced world is essentially relevant for the development of theoretical pictures, these theoretical pictures could also be considered as complete if we were able to observe a complete world. This is however not the case. Why?

The perception of complete reality in the sense of a precise reproduction implies that with growing fine structures, increasing information of the outside world is needed. Then, the evolution would have furnished the sense organs with the property to transmit as much information from the outside world as possible. But the opposite is correct: The strategy of nature is to take up as little information from the reality as possible. Reality outside is not assessed

by "complete" and "incomplete" but by "favorable towards life" and "hostile towards life". Concerning this point Hoimar von Ditfurth stated the following [6]:

> *"No doubt, the rule 'As little outside world as possible', only as much as is absolutely necessary is apparent in evolution. It is valid for all descendants of the primeval cell and therefore for ourselves. Without doubt, the horizon of the properties of the tangible environment has been extended more and more in the course of time. But in principle only those qualities of the outside world are accessible to our perception apparatus which, in the meantime, we need as living organisms in our stage of development. Also our brain has evolved not as an organ to understand the world but an organ to survive."*

The principle "as little outside world as possible" can be understood by means of the idea of evolution. The principle of evolution, i.e., the phylogenetic development from simple, primeval forms to highly developed organisms, can be considered as the key for the perception of reality of biological systems. It is the theory of evolution by natural selection which is generally accepted in the meantime. Its foundations have been created by Charles Darwin (1809–1882) more than one hundred years ago. Since then it has been modified and developed further by geneticists. Evolution by natural selection is a two-step process:

Step 1: By recombination, mutation, etc., genetic variants are produced at random. Populations with thousands or millions of independent individuals arise.

Step 2: Some of these independent individuals will have genes which enable them to manage the predominating situation due to the environment (climate, competition, enemies) better than others. Thus, they have a larger chance for survival than others; they will have, on the statistical average, more descendants than other members of the population. Natural selection takes place in favor of those organisms whose genes have adapted to better cope with the environment.

The number of examples that biological systems have developed in accordance with these criteria is overwhelming. Man and other creatures are characterized by this species-preserving appropriateness. The principle "as little outside world as possible" is compatible with the principles of evolution; it is a succession of evolution. Only those things that are useful for a human and other creatures are relevant. Therefore, the principle "as little outside world as possible" is in a certain kind a "principle of usefulness".

1.9. Inside World and Outside World

We experience the world by our sense organs, that is, the observer interacts with realty outside: information about reality outside flow via our senses into the body, and the brain forms a picture of it, and we obtain a "picture of reality". This is definitely a projection. In other words, we have a *reality outside* and an *inner picture* (picture of reality), and we are firmly convinced that the inner picture is identical with reality outside. For example, the well-known psychologist C. G. Jung wrote [7]: "*When one thinks about what consciousness really is, one is deeply impressed of the wonderful fact that an event that takes place in the cosmos outside, produces an inner picture, that the event also takes place inside* . . . ."

This statement by C. G. Jung suggests the following: There is a projection of reality onto space-time and the real world outside is also embedded in space-time. After Jung there is a one-to-one correspondence between the inner picture and the structures in the outside world. Whether or not the outside world is identical with that — which we called above "basic (absolute) reality" — remains an open question here.

1.9.1. *One-to-One Correspondence?*

After Jung there is a one-to-one correspondence between the inner picture and the structures in the outside world. However, such a view ignores the principle "as little outside world as possible", that is, the inner picture cannot contain the complete information about

the outside world. Again, the statement by C. G. Jung says nothing about whether the outside world is identical with absolute reality and, therefore, it says nothing about the absolute truth with respect to the inner picture. (We know from our analysis in the sections above that it cannot be the absolute truth.)

The common or naive point of view assumes the following: the inside world which we feel to be outside of us actually exists in the outside world in exactly the same form as we perceive. This was also the view of the psychologist C. G. Jung as we have already remarked above. According to this view there is only one difference between the inside world and the outside world: inside there are only geometrical positions, whereas outside there are the real material bodies instead of the geometrical positions. In other words, it is normally assumed that the geometrical positions are merely replaced by material objects.

But why should events in nature occur, so to speak, twice, one outside of us, and again in the form of a picture? This would be against the "principles of evolution" and the "principle of usefulness", respectively.

1.9.2. *Cinema and Cinema Ticket*

It would not make much sense if events in a world, which is tailored to fulfil the principle of usefulness, should take place twice. We ascertained in [8, 9] that in nature knowledge for its own sake does not play the major role but rather there is the recognition of the factors "hostile towards survival" and "favorable towards survival". For this purpose a consistent picture of an event occurring in the cosmos must be produced, but not a true reproduction in a one-to-one sense. In particular, such a picture does not need to be complete, because that would unnecessarily burden the biological organism in mastering specific situations in life. The solution of specific problems does not demand a complete knowledge of the world.

From the point of view of evolution the impressions before us are not precise reproductions of reality but merely appropriate pictures of it, formed by the individual from certain pieces of information from the outside world. According to the principles of evolution the central

factor is “favorable towards survival” versus “hostile towards survival”. The formation of a “true” picture of the world in an absolute sense, which is complete and that represents the absolute truth, is irrelevant. An individual registers situations in the environment in certain patterns which are tailor-made for the particular needs of the species and which are completely free of any compulsion towards precise “objectivity”. In particular, we have outlined [8, 9] that we have to assume that an

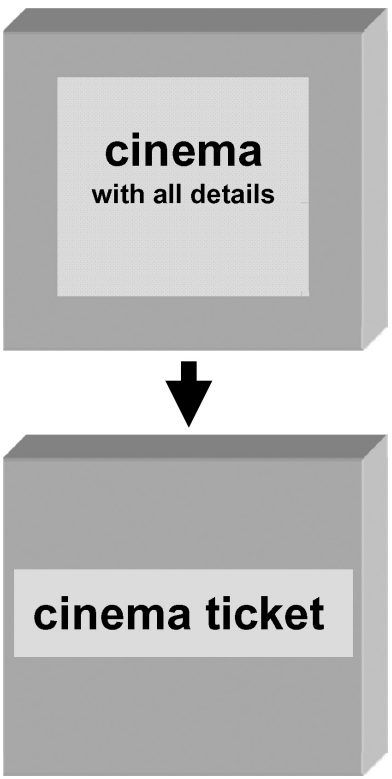

Fig. 1.2. The pictures which are formed by a human observer of the outside world are incomplete and, in particular, they cannot represent elements of the absolute truth. These pictures are primarily useful. So, for example, in order to find a certain place in a cinema, it is not necessary that the visitor gets at the pay desk a small but true model of the cinema, i.e., a precise reproduction of the cinema, which is reduced in size. A simple cinema ticket with the essential information, where one has to go, is more appropriate. In this respect the cinema ticket is the picture of the cinema.

event occurring in the cosmos is portrayed inside a biological system "only" in symbolical form.

Let us quote a simple example (see also [8, 9]). In order to find a certain place in a cinema, it is not necessary that a visitor gets at the pay desk a small but true model of the cinema, i.e., a precise reproduction of the cinema, which is reduced in size; a simple cinema ticket with the essential information is more appropriate. In this respect, the cinema ticket is the picture of the cinema (see also Fig. 1.2).

1.9.3. *Summary*

We experience the world by our sense organs and/or its properties are measured with certain measuring instruments. In everyday life the observer interacts with the outside world, that is, information about reality outside flow via our senses into the body and the brain forms a picture of it, and we obtain a picture of the outside world. Due to the principle "as little outside world as possible", the world, which is accessible to a human observer, cannot be complete and does not represent certain elements of the absolute truth.

A lot of scientists believe that the present theoretical structures of the physical laws represent the final and absolute truth. Self-indulgence is dominant! In the light of the biological evolution, the statements by Hawking, and Witten (Section 1.1) appear to be unrealistic; they are in particular misleading and wrong when the principles of evolution are taken into account. In nature cognition does not play the important role but the differentiation between "favorable towards life" and "hostile towards life".

1.10. Principal Questions

Now we are able to answer the questions that we have asked in Section 1.2: Can a human observer actually formulate the laws of nature independent of his own nature, that is, independent of his biological structure? Can we really find out "why" we and the cosmos exist? Both questions are of basic relevance because they contain another question: How general can a human observer formulate the laws of nature?

1.10.1. *Are Picture-Independent Physical Considerations Possible?*

The observer interacts with the outside world, that is, information about reality outside flow via our senses into the body and the brain forms a picture of it, and we obtain a picture of the outside world. Due to the principle "as little outside world as possible", the world that is reflected by the structures in the pictures must be species-dependent, and this is because the conditions for survival are different for different species.

Only species-dependent information is relevant for the formation of the pictures, and an observer has only access to the outside world over a picture formed by the observers' brain. This in particular means that only picture-dependent statements are possible for man since the species-dependent features exclusively come into existence through the picture. We are imprisoned in this system and cannot escape from it. In other words, a picture-independent point of view must be excluded. Statements about basic reality, which is by definition species-independent, are not possible for man. Thus, a human observer is principally not in the position to make statements about the "absolute truth", which is embedded in basic reality.

Then, we have to answer the question "Can a human observer actually formulate the laws of nature independent of his own nature, that is, independent of his biological structure?" negatively. The laws of nature, formulated by man, are dependent on his biological structure. The laws of basic reality are not accessible to man.

1.10.2. *Why Do We and the Cosmos Exist?*

Since man is principally not able to make statement about basic reality, he cannot say "why" we and the cosmos exist. Here the "why" refers to basic reality and, therefore, it is a "why" in the absolute sense. Then, we have also to answer the question "Can we really find out 'why' we and the cosmos exist?" negatively.

When we are able to derive a certain physical law (its mathematical structure) by a mechanism, we may state that this mechanism tells us "why" the effects, which follow from this physical law, happen.

The understanding in terms of mechanisms or models most often assumes an understanding of effects on the basis of mechanisms that we observe in everyday life. However, such a "why", such a mechanism, would be species-dependent and would not be valid for an other species, which have in general other everyday-life experiences than man.

1.11. How Does Science Progress?

We can also learn from the theory of science that the "absolute truth" remains principally hidden. To show this we have first to investigate the situation within the so-called "asymptotic convergentism".

1.11.1. *Science Progresses by Eliminating the Number of Unanswered Questions*

Let us suppose that there exists a defined set R_S of problems which, in the course of time, are solved, i.e., the questions asked are answered successively. If we denote the number of answered questions at time τ by R and the number of answered questions at time τ' ($\tau < \tau'$) by R', we get (see Fig. 1.3)

$$R < R'. \tag{1.1}$$

Accordingly, the number of questions capable of formulation decreases:

$$(R_S - R) > (R_S - R'). \tag{1.2}$$

Within the framework of such a principle all questions will be answered in the course of time, i.e., a maximum of scientific knowledge is achieved.

1.11.2. *Principle of Propagation of Questions*

In contrast to that, Immanuel Kant (1724–1804) advocated the "Principle of Propagation of Questions". This principle means that each answer to a scientific question gives rise to new questions. According to Kant this applies because each answer provides new material feeding new questions. But new questions generally change the supposition and this may lead to an extension of the problem

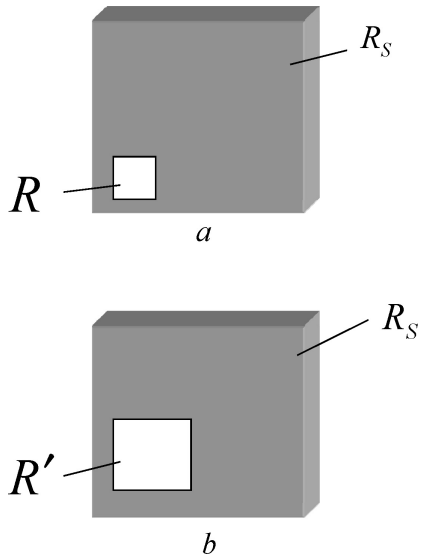

Fig. 1.3. (a) Knowledge at time τ: There is a constant number of R_S problems; the number of answered questions is R. (b) Knowledge at time $\tau' > \tau$: There are R_S problems; the number of answered questions is $R' > R$.

horizon: Instead of using Fig. 1.3, we are induced to read Fig. 1.4. Now a variable set of problems is encountered. Then, an increase in the number of unanswered questions can very well accompany an increase in answered questions. Since

$$R_S < R'_S \tag{1.3}$$

(see Fig. 1.4) the following relations

$$R < R' \tag{1.4}$$

$$(R_S - R) < (R'_S - R') \tag{1.5}$$

are possible.

However, the opinions of the scientists quoted above (Lord Kelvin, Feynman, etc., Section 1.5) can well be harmonized with Kant's "Principle of question propagation" provided that not only the number of questions but also their relevance is taken into consideration. As a matter of fact, if the relevance of a problem gradually decreases in the course of time, "later" science must be less important. In that case, it

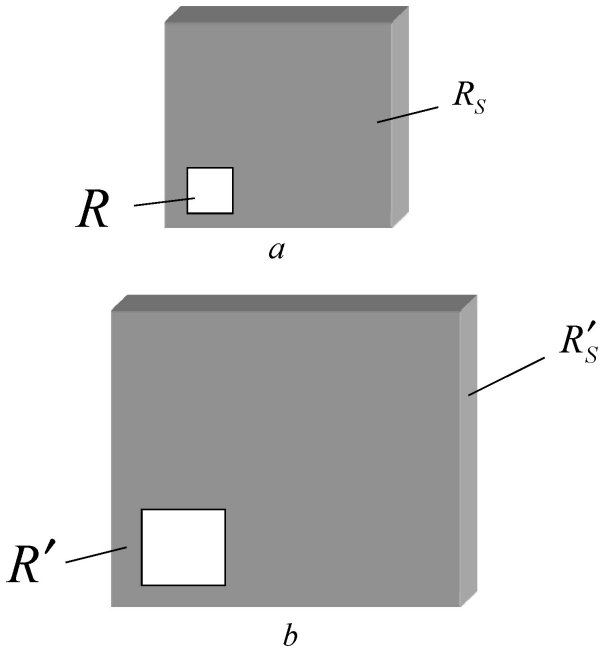

Fig. 1.4. (a) Knowledge at time τ: There are R_S problems; the number of answered questions is R. (b) Knowledge at time $\tau' > \tau$: There are R'_S problems; the number of answered questions is R'. The number of answered questions increases with time.

can be quite correctly asserted that the basic structure of physics has been worked out although the number of questions to be answered increase with time.

Such a view of the progress of science suggests the analogy with geographic research. In this context, Rescher states among others [4]:

> *"Scientific inquiry would thus be conceived of as analogous to terrestrial exploration, whose product — geography — yields results of continually smaller significance which fill in ever more minute gaps in our information. In such a view, later investigations yield findings of ever smaller importance, with each successive accretion making a relatively smaller contribution to what has already come to hand. The advance of science leads, step by diminished step, toward a fixed and final view of things."*

Accordingly, science progresses by approaching the truth successively: The "final answer" and the "final view" of things, respectively, is gradually approached by the way of an asymptotic approximation. According to Peirce (1839–1914) this truth is obtained in the limit $\tau \to \infty$:

$$R_\infty = \lim_{\tau \to \infty} R_\tau, \tag{1.6}$$

where R_τ is the time dependent status of knowledge which approaches asymptotically the definite truth R_∞. This detailed filling (accumulation) of given, fundamentally defined patterns resembles greatly the calculation of further decimal points in order to additionally refine a result already roughly estimated, such as in calculating the numerical value of:

$$\begin{aligned} \pi_1 &= 3,1 \\ \pi_2 &= 3,14 \\ \pi_3 &= 3,141 \\ &\vdots \\ \pi &= \lim_{n \to \infty} \pi_n. \end{aligned} \tag{1.7}$$

At least until one generation ago, the opinion was firmly established that science is cumulative and the advocates of the scientific method tried to understand scientific progress to have this cumulative nature (see also [4]). Within this concept the "absolute truth" is set equal to "our ultimate truth". But we will see below that the asymptotic convergentism cannot be upheld in the recognition theory and scientific history.

1.11.3. *Substitution Instead of Successive Refinement*

All the statements cited in Sections 1.1–1.6 can be classified on the basis of the asymptotic convergentism. However, essentially two serious objections can be quoted against the statements in Section 1.11.2, i.e., against the asymptotic convergentism:

1) There is no metric to measure the "distance" between bodies of knowledge
The asymptotic convergentism is from the beginning burdened by the great difficulty that it cannot give a metric system allowing us to define the interval concerning

$$R_\tau - R_{\tau'}$$

between the status of knowledge R_τ and the status of knowledge $R_{\tau'}$. This means that we are not in the position to decide whether or not we have approached the real truth. How can criteria be formulated which allow such an approximation, that is, to find a metric that is able to measure the "distance" of knowledge? We cannot! There is simply no neutral standpoint in theoretical terms, i.e., no neutral, elevated level (external to science) which could form the basis for a direct comparison between theoretical configurations R_τ and $R_{\tau'}$, etc. Scientific progress can only be measured in connection with the so-called pragmatic level; this point will be outlined in more detail below.

2) There is a fundamental change in perspective
The assumption of a successive approximation cannot be maintained in view of the history of science because the analysis of theories succeeding each other in time shows that the later theory is generally not only supplemented and refined, respectively, but reformulated on the basis of new first principles. A basic change in perspective takes place. Normally the problem does not consist of just adding some further facts but of structuring a new frame of thinking. This situation has been described in a highly instructive manner by Thomas Kuhn who compared Newton's theory to the Theory of Relativity [10] (Einstein' theory), as compared to Newton' theory, provides a basically novel frame of thinking. A change of perspective has taken place, involving the notational decoupling and displacement, respectively, of the network of notions.

Estimates of the truth

Generally speaking, we have to conclude that a "later" theory became necessary because the "earlier" theory had been limited in its scope. This led to a basically novel concept of the way of seeing nature. Thus, normally, not only improvements and refinements, respectively, are made, but the "earlier" theory is downright replaced by the "later" one. The history of science provides a wealth of examples supporting this statement [4, 10]. Therefore, we have to assume consistently that the "later" theory will also have to be abandoned at some point in time. So, each frame of thinking, independent of the era in which it has been conceived, can never constitute a frame for the "absolute truth". In this context we cannot even provide evidence that we have come closer to the "absolute truth" because no metric system can be defined to measure intervals in recognition. A framework of thinking and a theory, respectively, do not reflect the "absolute truth" but, as formulated by Rescher [4], an "estimate of the truth", which is to be understood as meaning of a tentatively postulated provisional truth.

Incommensurable structures of thinking

When changing from one to another frame of thinking, generally a conceptual decoupling takes place so that successive structures of thinking may become incommensurable. The advocates of incommensurable theories are basically not in a position to understand each other, because it is not reasonable to make comparisons between incommensurable structures of thinking. Using the following analogy, Rescher reduces the problem to the point [4]: "*One can improve upon one's car by getting a better car, but one cannot improve it by getting a computer or a dishwashing machine.*"

The pragmatic level

Scientific progress can be defined only if it is possible to project certain tendencies of two incommensurable structures of thinking to one "appropriate" third level (Fig. 1.5). This third level, which is a sort

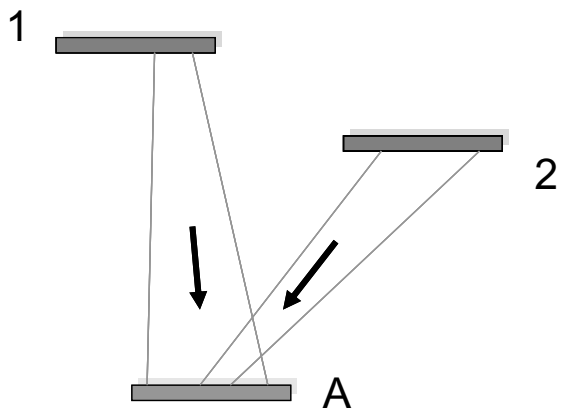

Fig. 1.5.

of reference system (level A in Fig. 1.5) generally will have a "coarser" and "more global" structure than the two incommensurable structures of thinking (levels 1 and 2 in Fig. 1.5). Level A is coarser and more global because, generally, such a projection is not detailed, i.e., a point by point projection and provides only an integral picture (e.g., by averaging). These integral variables of level 1 and level 2 have things in common, if they cover a joint zone on level A. Level A is "appropriate" for comparing two structures of thinking, if it offers to them a finite surface for projection. A structure of thinking is superior to another if it describes in more detail and accuracy the body of facts on level A. In this way it is possible to compare (albeit to a limited extent only) two competing theories. In Fig. 1.5 the structures of thinking underlying level 1 is superior to that of level 2 because the surface (equivalent to the status of recognition which, starting from level 1, explores level A) of level 1 projected onto level A is larger than the surface of level 2 projected onto level A.

Related to the situation of man, level A might constitute the level of everyday life, of technological applications, and of experimental explorations. Thus, technological progress and the elucidation by experiments become the touchstone (albeit to a limited extent) of deviating theoretical positions. Applying this yardstick, a "later" theory must preserve and improve the practical successes of its predecessors;

it is then superior to the "earlier" theories. But it must always be kept in mind that the judgement of a given structure of thinking from the pragmatic level provides only a restricted perspective.

Scientific progress defined in this way will depend in many domains essentially on the technological progress because natural science often needs a more sophisticated technology in order to perform its increasingly complicated interactions with nature. According to what has been said before, from the cognitive point of view, natural science repeatedly starts from its origin; however, given the limits imposed by technology, this process, for merely practical reasons, will proceed at an ever slower rate.

1.11.4. *Summary*

Within the asymptotic convergentism it can rather be assumed that the world is actually as science envisages it to be. Here, fundamentally new pictures of the world are not generated again and again, but one frame is filled successively. In that case the concept is justified that theoretical terms like electrons, quarks, etc. are actually existing entities in the world. However, as already outlined in detail above, the asymptotic convergentism can no longer be upheld. The empirical finding (resulting from the analysis of facts provided by the history of science) that science progresses by a sequence of incommensurable schemes of thinking (pictures) must be given a rank equal to that of a relevant experiment in a laboratory. In this connection the following point is relevant: Because a metric for the measurement of the "distance" between bodies of knowledge is not definable, there is no possibility to express certain peculiarities of the absolute truth and basic (absolute) reality, respectively.

1.12. Final Remarks

We have asked the following important question: Can the progress in science, in particular in physics, lead to a final truth of the physical world? It cannot! The absolute truth, which is so to speak embedded in basic reality, can never be observed and, therefore, theoretical considerations about it make no sense.

The perception of complete reality in the sense of a precise reproduction implies that with growing fine structures increasing information of the outside world is needed. Then, the evolution would have furnished the sense organs with the property to transmit as much information from the outside world as possible. But the opposite is correct: The strategy of nature is to take up as little information from the reality as possible. Reality outside is not assessed by "complete" and "incomplete" but by "favorable towards life" and "hostile towards life".

The common or naive point of view assumes the following: the inside world which we feel to be outside us, actually exists in the outside world in exactly the same form as we perceive. According to this view there is only one difference between the inside world and the outside world: inside there are only geometrical positions, whereas outside there are the real material bodies instead of the geometrical positions. In other words, it is normally assumed that the geometrical positions are merely replaced by material objects.

But why should events in nature occur, so to speak, twice, one outside of us, and again in the form of a picture? This would be against the "principles of evolution" and the "principle of usefulness", respectively. It would make not much sense if events in a world, which is tailored to fulfil the principle of usefulness, would take place twice. In this connection we stated the following: "*From the point of view of evolution the impressions before us are not precise reproductions of reality but merely appropriate pictures of it, formed by the individual from certain pieces of information from the outside world. According to the principles of evolution the central factor is 'favorable towards survival' versus 'hostile towards survival'. The formation of a 'true' picture of the world in an absolute sense, which is complete and that represents the absolute truth, is irrelevant. An individual registers situations in the environment in certain patterns which are tailor-made for the particular needs of the species and which are completely free of any compulsion towards precise 'objectivity'.*" So, a visitor of a cinema does not get at the pay desk a small but true model of the cinema (a precise reproduction of the cinema,) in order to find a certain place in the cinema, a simple

cinema ticket with the essential information is more appropriate. In this respect, the cinema ticket is the picture of the cinema.

The facts from the theory of science have taught us that we will never be able to make final and complete statements about the physical universe, i.e., from the point of view of theory of science the "absolute truth" can never be obtained. Why? Because a metric for the measurement of the "distance" between bodies of knowledge is not definable, there is no possibility to express certain peculiarities of the absolute truth and basic (absolute) reality, respectively. An absolute reality may exist within theory of science but it is not accessible to man.

The results that follow from the theory of science strongly confirm the statements, which we have worked out in connection with the principles of evolution and the principle of usefulness, respectively.