

(This is a part of the book [The Concept of Reality.pdf](#))

Introduction

1. Do we need a New Understanding of Nature?

*Historical remark; criticism of the status quo of physics and philosophy; listing of open questions and unsolved problems – however only of such which a solution will be proposed to in the following.*¹

The basis of the currently prevailing view of nature is the assumption that everything which exists and which occurs can be traced back to the motion of elementary entities that interact with each other.

At the beginning of his famous "Lectures" (first passage of 1-2), Richard Feynman tells us:

"If, in some cataclysm, all of scientific knowledge were to be destroyed, and only one sentence passed on to the next generations of creatures, what statement would contain the most information in the fewest words? I believe it is the *atomic hypothesis* (or the *atomic fact*, or whatever you wish to call it) that *all things are made of atoms – little particles that move around in perpetual motion, attracting each other when they are a little distance apart, but repelling upon being squeezed into one another.*"

The past history of this conception of the world is quite a short story. Its inventors are Leucippus and Democritus. They thought the world as consisting of very small, changeless particles of different shape, moving permanently, without cause and forever.

Dynamics – the theory of the movement of objects – begins with Aristotle. He differentiates between two kinds of movement: Objects move either because they aim at their natural position, or because they are forced to move by an exterior cause that must directly touch them. When they have reached their natural position – the heavy things at the bottom, the light things above – and if no exterior force is acting on them, they remain at rest.

This gives rise to the question of why a stone that is thrown upwards is still moving upwards when it has left the hand. According to Aristotle the answer must be: Because the medium surrounding the

¹ As regards any of the listed problems, I assume you will be profoundly convinced that there is no alternative to the current view. However in the course of my deliberations it will become apparent that this is not true. (As Sledge Hammer said before every disaster: "Trust me, I know what I'm doing.")

stone – the air, which is set into motion by the movement of the arm – is continually acting on the stone, forcing it to move further.

However the air seems all too thin to be qualified for exerting such a force on a comparatively heavy stone. (Try blowing.)

After quite a long time – in fact not before the Middle Ages – this contradiction led to the hypothesis that the cause for the continuous upward movement of the stone cannot be found in the movement of the air but has to be seen as an attribute of the stone itself: the throwing motion provides the stone with a so-called *impetus* (a predecessor of the modern momentum), which is driving the stone upwards while gradually weakening until it has completely dwindled away, leaving the stone again to its drive toward its natural position at the bottom, where at last it will come to rest.

The next step came from Galileo. He developed the concept of frictionless motion which never stops, that is: of impetus as a conserved quantity.

At last, Newton used this concept as basis of the general law of motion. It reads as follows:

"Every body persists in its state of being at rest or of moving uniformly straight forward, except insofar as it is compelled to change its state by force impressed."

Thus force is no more necessary for maintaining motion but for changing it, and therefore it holds that:

"The change of momentum of a body is proportional to the impulse impressed on the body, and happens along the straight line on which that impulse is impressed."

In the formulation of Leonhard Euler: $\mathbf{F} = M\mathbf{a}$ (Force is equal to mass times acceleration), or, in a differential notation: $\mathbf{F} = d(M\mathbf{v})/dt$.

Together with the assumption that every object is not only driven by exterior forces but is itself also in any case the source of a force, which means that every object that exists interacts with other objects, this law still represents – in spite of relativistic and quantum-mechanic modifications and additions – the basis of contemporary physics.

In this way it becomes the starting point of an almost unbelievable success. The present knowledge about nature allows us insights in all areas of reality, from the smallest to the greatest, and in the form of technology this knowledge has permeated all spheres of life and has changed the face of our planet.

Now the question is: If a concept is so overwhelmingly successful – does that mean it is also true? As we have learned from examples in the history of physics, the answer is *no*.

Newton's theory of gravity for instance was enormously successful, but in spite of its success it was superseded by Einstein's General Theory of Relativity, whereby the conceptual basis has been completely modified: the attracting force between masses has been replaced by the curvature of the space-time continuum.

So let us pose the question: *Is the conceptual basis of contemporary physics ultimately correct?*

At least there are some reasons to doubt this assumption. They can be divided into three groups:

1. The failure of any attempts to develop the foundations of physics beyond the standard model of particle physics.

In the last decades, the most important project of theoretical physics has been, and still is, the uniform description of the four fundamental interactions. Apparently it is possible to associate any of these interactions with a group structure. This suggests associating the desired unified interaction with a group that contains these four groups. The definiteness of the mathematical structure which the realization of this purpose leads to, has, for a long time, nurtured the hope that at the end of this way there might also be a definite, unique theory. This hope has not been fulfilled. In any case the mathematics of the unifying process involves additional, "rolled up" dimensions which the topology of the theory depends on. However this topology is by no means unique; for this reason (and for some other ones), the present superstring scenario allows for more than 10^{500} different theories.

Also the second objective, the reduction of the number of *free parameters*, has not been accomplished. On the contrary – the unification mechanism enforces the assumption of additional, unknown quantities, e.g. masses of new particles, and also in this case there is nothing but an uncertain hope that these new free parameters could eventually turn out to be the consequences of hitherto unknown mechanisms – maybe symmetry breakings.

Without any doubt this is very disappointing! Or is it? Surprisingly, in just the same way as it happens in stage plays or in novels, when the situation of the hero has become so desperate that the progress of the story cannot be maintained by reasonable actions – think for example of the passage in the novel "The Hitchhiker's Guide to the Galaxy", where the protagonists are thrown out from the spaceship of the Vogons into empty space –, also in the case of the superstring theory suddenly a saving *deus ex machina* appears. In "The Hitchhiker's Guide to the Galaxy", it is the spaceship "Heart of Gold" with

its Infinite Improbability Drive, in the superstring scenario it is the *multiverse*, a combination of an infinite number of universes and chance. So even if superstring theory has fallen at the hurdle of deducing a unique theory, this combination assures that *every* universe, which corresponds to one of the 10^{500} theories and, moreover, to *any* possible set of free parameters, is actually realized. Therefore from a – to put it mildly – very optimistic point of view one might say that superstring theory has reached its goal to explain *our* universe.

However with its special free parameters, which are very fine-tuned as regards the development of physical, chemical and biological structures, it is admittedly an extremely improbable universe. Still, there is no reason to be surprised that we live in such an improbable universe, because any such amazement immediately calms down at the so-called "anthropic principle": We don't need to be astonished, because if not everything were as it is, we would not exist at all. Therefore we *have to be* in such a universe.

Of course this is true, but only in the sense that the actual present allows to determine which past is possible, and not in the sense of an explanation, why our universe is as it is. We can find out the necessary conditions for the present, but the present is not the *explanation* for these conditions.²

It is important to see that the combination of chance and infinitely many possibilities is actually *never* an explanation; instead, in the game of cognition, it represents a universally applicable joker, just like the assumption of an almighty god: both are able to explain *anything*, which means they actually explain *nothing*. This can easily be proven by the following thought experiment: Let us assume there were no physical laws at all. Everything which happens occurs completely by chance. Still there must exist – as one of the infinitely many universes – our own universe; a universe, that is, where purely by chance everything up to now has happened *as if* the known laws of nature were in effect. Of course the probability is enormously high that at the next moment everything will disintegrate – however again we must not wonder about this unfathomable enduring improbability! As mentioned above: if not everything were as it is, we would not exist at all, and so on and so forth...

However this does not mean that the scenario of infinitely many universes and chance can be ruled out completely – but, as stated before, it would be a great disappointment if this were our *summa scientia*.

² Currently some physicists consider the possibility of the generation of life in our universe actually as an explanation for the values of free parameters. (E.g. Steven Weinberg in *Anthropic bound on the cosmological constant*, Phys. Rev. Lett. **59**, 2607, 1987). One can hardly believe that, in this way, the *causa finalis* which stems from prescientific reasoning comes back to physics. Such assumptions should not be discussed as part of natural science but as psychological phenomena, as symptoms of failure, which illustrate in a dramatic manner the explanation crisis in modern physics.

Does the answer to the question if the interactions can be unified on the path hitherto pursued actually relate to the conceptual fundament of physics? I think yes: *If* particles and interactions are in fact the basis of the description of nature, then everything else seems determined, in other words: then there is probably no alternative to the known proceedings.

2. *The accumulation of observational facts, the relationship of which to known physics is not clear.*

At present, 96 percent of what the universe contains is completely unknown. For 22 percent – the so-called *dark matter* – there are some candidates in various speculative concepts beyond the *standard model* of particle physics, however as regards the remaining 74 percent – the so-called *dark energy* – we are utterly ignorant.

Isn't this to be interpreted as evidence that the conceptual basis of physics and the models built upon it are challenged and called into question like never before? Wouldn't it be appropriate, in view of such a vast *terra incognita*, to ask anew the most general and most fundamental of all questions: *What is the world actually made of?*

In the framework of contemporary physical concepts, *dark matter* and *dark energy* are indispensable. Without them, neither the dynamics of the objects in the universe nor the history of the universe can be described. However the question arises how far such *ad hoc* concept formations are justifiable, which have only been created to fill out explanation holes and for which, in spite of extensive research, no physical habitat has been found up to now.

Shouldn't instead the alternative be considered that the correct answers lie out of the reach of our hitherto used concepts of matter, of gravity and of the cosmos and that this fact is only clouded by the two *dark concepts*?

3. *The total loss of understanding and insight as the downside of the formal and technical success.*

The reservations against the gravitational force assumed by Newton were at first directed at the fact that it was actually an *occult* force: it seems impossible that an object can attract another object through empty space. In this way, physics has been associated with unthinkable entities already from the very beginning. However in the following the success of the physical theories repressed all philosophical doubts from the awareness of physicists – to such an extent that Heinrich Hertz could write in the year 1889:³

³ Heinrich Hertz, *Die Prinzipien der Mechanik in neuem Zusammenhange dargestellt: Drei Beiträge (1891-1894)* (Ostwalds Klassiker der exakten Wissenschaften, Nr. 263) Reprint of the Edition Leipzig: Akademie

"Wir machen uns innere Scheinbilder oder Symbole der äußeren Gegenstände, und zwar machen wir sie von solcher Art, dass die denknötigen Folgen der Bilder stets wieder die Bilder seien von den naturnötigen Folgen der abgebildeten Gegenstände. Damit diese Forderung überhaupt erfüllbar sei, müssen gewisse Übereinstimmungen vorhanden sein zwischen der Natur und unserem Geiste. Die Erfahrung lehrt uns, dass die Forderung erfüllbar ist und dass also solche Übereinstimmungen in der Tat bestehen."

("We make inner images or symbols of outer objects, and we make them in such a way that the logically necessary consequences of the images are again in any case the images of the naturally necessary consequences of the depicted objects. To satisfy this postulate, there must be certain correspondences between nature and our mind. Experience teaches us that the postulate can be satisfied and that such correspondences do indeed exist.")

Only a few years later, this optimistic view of the connection between nature and mind seemed to be falsified once and for all. Exactly those experimental observations which in the following led to the theory of special relativity and to quantum theory could not be transferred into logically necessary images. (E.g. the Michelson-Morley Experiment or the Photoelectric Effect.) This results in a change of the ontological status of physical concepts. According to the Theory of Relativity, light is no longer a wave but merely a phenomenon that satisfies a wave equation. Also the elucidation of the relationship between space and time, or matter and energy, must content itself with the reference to mathematics.

According to quantum mechanics, reality divides into two different parts: part 1 is what appears in our observations and measurements – this is the reality which we encounter in our everyday life and which we believe to understand intuitively. Part 2, which represents the *actual* – that is: *causative* – reality, is what occurs *between* observations – so to speak "behind the curtains". According to the contemporary understanding of quantum mechanics, there can be no longer any conceptual interpretation at all of the events between experimental input and output. They are not only invisible but also inconceivable. Equations turn into input-output relations, and the relationship between elements of the mathematical structure and elements of part 2 of reality remains unexplained.

There is also the problem of the transition between the two parts. Part 2, the hidden reality, cannot bring forth part 1, our well-known reality, until a sudden change occurs, an act hitherto not understood – the so-called *reduction of the wave function*. Though it is presupposed in quantum mechanics, the theory provides no information what it actually is. Up to now it remains a secret why and how it occurs.

Verlags-Gesellschaft Geest und Portig 1984, Thun, Frankfurt am Main 1996, S. 67.

Therefore the world turns into a kind of black box. As we cannot look into the box and as there is no rationally conceivable description of what happens within it, every attempt to interpret its contents must fail. It is no longer admissible to ask what happens in between two observations. Conceptual or pictorial cogitation is reduced to a mere heuristic function in the service of mathematics.

Examples which illustrate these circumstances – e.g. the "double slit experiment" – are not meant to provide any understanding of what actually happens but to demonstrate that it is inconceivable.

Let us again listen to Richard Feynman:

"I think it is safe to say that no one understands quantum mechanics. Do not keep saying to yourself, if you can possibly avoid it, 'but how can it be like that?' because you will go 'down the drain' into a blind alley from which nobody has yet escaped. Nobody knows how it can be like that." ⁴

Thus physics has dismissed the demand of enlightenment to understand the world, or, to put it correctly, it has failed completely. What remains are mathematical models that enable us to make probability statements about events. However our view of the world has already merged with physical modeling to such an extent that we regard the failure of reasoning and the disappearance of reality connected with it – if we notice it at all – as inevitable or even as a matter of course.

This is due to the fact that physics claims to be universally valid: Everything which happens must obey the laws of nature. Therefore it seems as if the physical description applied to the fundamental layer of reality. If this is true, then, however, there is no way to recover the world if it has slipped out of the physical concept formation.

The last and apparently decisive stroke against all attempts to describe the world in an understandable manner was performed by John Bell. In 1964 he succeeded in deducing an inequality⁵ from which follows – at least according to general conviction – that there is no possibility to reproduce the (experimentally verified) predictions of quantum mechanics on the basis of a local and objective theory.⁶

⁴ Richard Feynman, *The Character of Physical Law*, Penguin 1992, p. 129.

⁵ John Stewart Bell, *On the Einstein Podolsky Rosen Paradox*, Physics, 1, 195-200 (1964).

⁶ *Objective* means: things are as they are, independent of our existence and of our observations. *Local* means: an event can only be influenced by another event via a process the speed of which is not greater than that of light.

However "local und objective" are indispensable ingredients of "reasonable and conceivable". Thus it seems to be proven that it is impossible to represent the world by models which are compatible with our thinking.

In spite of the fundamental relevance that physics has with respect to our worldview, the question if we need a new understanding of nature cannot be answered within the realm of physics alone. So I shall now end my *lamento sulla fisica* and put this question into a philosophical context.

What is lacking in the contemporary understanding of nature? Which important questions remain unanswered? Which important problems are still unsolved?

Beyond the realm of natural science, the glamour of success fades away quite quickly and gives way to the dreary twilight of intellectual disaster and human deficiency. There is no answer to many central questions. Some of them are considered unanswerable – however apparently without sufficient reason, some are nearly forgotten, and some are clouded by terrible confusion.

Let us start at the very basis. In any case, the first question is:

Why is there anything at all and not just nothing?^{7 8}

Here, all we can find is absolute helplessness. The same applies to the following question, too:

What is that what exists? What does it ultimately consist of?

Everything that exists needs at least a material carrier. However even if it is identified with this carrier, any attempt to answer this question breaks down at the inaccessibility of physical concepts. For what *is* matter, what *is* energy? After the disappearance of the ostensible vividness which, at the beginning, seemed to be suggested by the simple designations, it is now completely clear to us that physical conceptions are just elements of a mathematical scheme. But the world is not just mathematics – it *exists!* Thus, ultimately we don't know about *anything* what it actually is. We don't know what *existence* is.

⁷ Sometimes one can hear that the *creatio ex nihilo* were a quantum jump out of nothing. This cannot be taken seriously: Quantum jumps occur in the quantum vacuum, not in *nothingness*, and the *nothingness* cannot simply be identified with the quantum vacuum.

⁸ I shall not discuss any religious ideas. After the elimination of psychological projections (fears, wishes, ideals, fantasies etc.), notions like "god" or specifications like "outside of space and time" are completely empty. There is no more to say to that.

In the case of entities that cannot be reduced to other, simpler entities – in other words: in the case of elementary entities – it remains also a secret *why* they are as they are. It cannot be asked: *Why* does an electron carry electric charge? *Why* does matter curve space-time?

Indeed this seems to be true – put aside the aforementioned limitations which are imposed on any "what is" and "why" questions by the contemporary interpretations of relativity and of quantum theory – because these questions are limited by an *a priori* and, accordingly, insurmountable border: by the thinking scheme of *substance* and *accident*. As follows:

Everything which exists must necessarily be thought as consisting of *substance* and *accidents*.⁹ However physical descriptions and explanations can only act within the area of the accidents. As the accidents, however, are logically completely separated from the substance, the substance is never reached. From this follows that, in the case of elementary entities, we can never ask the "what is" question – this would precisely be the question about the substance – nor the "why" question, because that would mean understanding an attribute of an entity – an effect exerted by it – *out of the entity itself*, and that would require a logical connection between substance and accidents.¹⁰

Let me give two examples. The question what an electron *is* can only be answered by listing its attributes. The question what it consists of – that is: what it actually *is* apart from these attributes – is senseless. *Why* it has these attributes, remains hidden.

Or consider the question "What is mass?" Again we can only answer by using the accident: mass exerts gravitation. In Newtonian physics, gravitation is an attracting force between masses. However *why* this force exists has to remain unanswered. General Relativity describes gravitation as curvature of the space-time. In this way it replaces the Newtonian action at a distance by a differential action. However it cannot explain either, *why* space-time is curved by matter. This attribute (accident) of matter is completely separated from the notion of *mass itself* (from the substance). Therefore, gravitation – as well as any other interaction and any other (fundamental) physical circumstance – is a phenomenon which must simply be taken as a fact that cannot be explained any further.

This means: As long as we hold on to the idea that the world consists of elementary entities – which necessarily divide into substance and accidents –, we cannot know *what* the world is nor *why* it is as it is.

⁹ For the moment it is sufficient to understand "substance and accidents" as "thing with attributes".

¹⁰ In the case of entities which are *not* elementary, a reductionistic answer can be given. E.g.: What is water? An aggregate of H₂O-molecules. In the case of elementary entities, there is no such possibility.

Another unsolved question is the one about the nature of time.

What is time?

We don't know what time actually is. In physics, time becomes spatialized. However by this very act the nature of time gets lost. If one, as Albert Einstein in his late years, understands reality as kind of a four-dimensional block, then one has to explain why *for us* the present is a permanently forward moving (hyper-)plane of this block, that is: why the time coordinate is not available for us in the same way as the three space coordinates. However such an explanation is not in sight.

Also the following two questions, with which we are occupied since Plato and Aristotle, are still waiting for answers.

What is the relationship between law and individual case?

It is easy to say that "the laws of nature apply" or that "anything which occurs obeys the physical laws". But *where* should these laws be? *How* should they act on that which occurs?

Obviously, already the idea alone that they do act somehow *on* an entity is so absurd that one seems to be forced to deny the laws – i.e. the *general* – any existence und to regard only the *individual* – that what happens in any given situation – as real. Then, however, it becomes already an unsolvable problem to reason why identical cases should have identical consequences¹¹, because in order to assume they are identical and must therefore be seen as *one and the same case*, there must be the *general* under which they can be subsumed.¹² All of a sudden one feels thrown back into the medieval universals controversy while realizing at the same time that none of the two positions can be correct. Up to now, this problem – which, after all, concerns the core of any description of the world! – remains unsolved.

Can that what exists be divided infinitely or is there a limit of divisibility?

In modern physics, this question seems to be decided. However actually nobody believes seriously that the *standard model*, which contains quite a considerable number of indivisible entities, represents the ultimate description of nature. In fact this cannot be the case because its applicability is limited.

¹¹ Here, consequences can also mean *probability distributions*.

¹² *One and the same case* would be precisely this general, from which would follow that all individual cases which correspond to it are also equal among themselves.

However, independently from this question and more generally spoken, does not everything that exists have to be *originated*? And, therefore, isn't it unsatisfactory to assume that the universe consists of elementary, unchangeable elements – just like a *building set*?

The last two points in my list of unsolved problems of our worldview are also the most significant ones, as they refer to our self-understanding:

What is mind?

At present, it is impossible to explain the emotional aspect of mental states, the fact that in our mind *information* is always accompanied by *feeling*. What *qualia* are – e.g. the perception *red*, or the sensation *pain* – is not contained in any description.

We could also ask:

How is it possible to think of mind and matter as elements of *one and the same* conception of the world, without depriving at least one of these two phenomena – both of which, after all, seem so familiar and intuitively understandable to us – of its very nature?

Is it actually possible to assume mind as an autonomous entity within a nature that seems completely determined by laws? Are mental processes *nothing but* neuronal processes? Does the fact that they are *qualia* not prove that they are *more than* that? However if this is indeed the case, how can they then be understood as *natural* phenomena? Or do we have to content ourselves with interpreting this problem – as Kant did – as a pure, unsolvable *antinomy*?

The last question is closely related to the previous one. Yet it deserves to be formulated separately:

Does free will exist?

Surely it is not necessary to emphasize that a worldview in which the last two questions cannot be cleared up suffers from a fundamental defect that must be corrected urgently. Otherwise it could happen that we incline – or even fall prey – to any peculiar irrationalisms, e.g. that we take ourselves for the zombies that we are in reductionistic or functionalistic explanations of mind, or that we try to remedy our ignorance through the assumption of immaterial entities.

With this, I shall end my catalogue of contemporary cognition deficiencies and finish with a short summary:

The great potential of the current scientific worldview is based on the underlying conception of reality as a building set that consists of interacting particles.

On the one hand, this conception enables us not only to describe many areas of reality with great accuracy but also to devise and construct new scenarios – all the astounding technical achievements originate from it.

However as magnificent the building set and the technical constructions based on it may be, as depressing are, on the other hand, its deficiencies:

The operations that can be executed with the basic elements of the building set are performed out of our sight within a *black box*. Though it is possible to assign to any input a specific set of output events together with the according probability distribution, it is outright impossible to conceive an idea of *how* the output develops from the input – to that what happens within the box cannot be assigned *existence* in the usual meaning. Reality is vanishing away.

Neither do we know how our universe has originated nor why it exists at all.

We do not know what it consists of and why it is as it is.

We are incapable of understanding the change of the essence of being that occurs in the evolution of nature to entities of ever more complexity. However at the known end of this evolutionary development we find ourselves, and this means that we have no concept of ourselves. We do not know who we are and what our status in the cosmos is.

However as we are a part of nature, the concept of ourselves *must* be contained in our understanding of nature. Yet this is not the case in our current view. Therefore, this view must be wrong or incomplete.

Surely we need a deeper and more comprehensive understanding of nature.

2. Announcements

Historical note; outline of the structure of the book; unsystematic remarks.

2300 years ago (!) Aristarchos of Samos explained many of the observable celestial phenomena – among them also the temporarily reverse motion of the planets the interpretation of which has caused so much difficulty within the geocentric system – in a simple geometric manner by the assumption that the earth circles around the sun annually and rotates around its own axis daily. Back then the objections were already the same as those brought up against Galileo approximately 1900 years later: Shouldn't the motion of the earth make itself felt? Wouldn't storms follow from it? Shouldn't objects fall to the ground angularly?

That's a beautiful and characteristic example for the fact that it is always simple geometric evidence which leads to the right way and ultimately wins through. Against it, any knowledge that appears ascertained within the horizon of the just prevailing worldview, in the course of time fades out to a mere prejudice.

Why do I mention this episode? Because I see myself in a similar position: in the following, I will present a new physical and philosophical view of nature based on simple, often geometric arguments, a view, in which all conclusions appear to be reasonable and evident, which, at that, provides a solution – or at least a clear suggestion for a solution – for all the questions and problems mentioned in the previous section, – which, however, contradicts present scientific doctrines in nearly every respect.

The path to this new understanding of nature divides into three parts:

The First Part is criticism and correction of the interpretation network of contemporary physics.

In the first decades after 1900, physics faced greater challenges than ever before. The supposedly secure foundations of the Newtonian description of nature began to falter, the relativistic and quantum mechanical revolution started. Right here, at this point of the historical development, there would have been the chance to deepen the knowledge of nature by recognizing the real context.

This opportunity has been lost. Although the physicists of that time succeeded in describing the crucial scenarios – like e.g. the Michelson-Morley experiment, or the double-slit experiment – in a formally correct way, all attempts to form an idea of what is *actually* going on came to naught. This means, however, that the *understanding* of relativistic and quantum-mechanical circumstances is still missing,

so that the entire interpretative connexion is misleading to this very day. This is the reason for interpretative lack of clarity, paradoxes and, quite generally, for the *vanishing of reality*.

The first necessary step to abolish the fatal consequences of this historical failure is to disprove the general conviction that the so-called EPR scenario¹³ cannot be described by a theory with solely local parameters, in other words: that the measurements on entangled Systems predicted by quantum theory and verified experimentally cannot be reproduced by any local theory.

Thus I show at first, using the example of entangled photons, that such a local theory does indeed exist, and explain why Bell's proof that seems to rule out this possibility does not apply in this case.

Then follows a new interpretation of special relativity, by which it is cleared up *why* nature obeys the space-time measures determined by light signals. (Actually it is not a *new* interpretation, because the term "interpretation" is only justified if such an explanation is available. However as this has not been achieved up to now, my explanation of special relativity is in fact its *first* interpretation.) Here, special relativity follows from purely logical reasoning, without the use of the postulate of relativity or the postulate of the constancy of light speed for all uniformly moving observers. In this way, special relativity obtains the status of a fundamental ontological fact, independent of any kind of physics.

Thereafter the scenarios are discussed through which the mechanical concept of particles has been introduced into the description of radiation, which had previously been understood as a pure wave-phenomenon: the Photoelectric Effect and the Compton Effect.¹⁴ It turns out that in both cases a very simple alternative has been overlooked.

These alternative descriptions confirm the local model of the EPR scenario presented just before and lead directly to a local and objective interpretation of quantum theory, the basis of which is the explanation of the reduction of the wave function, that is: of the sudden jump from the realm of the interfering quantum mechanical wave-functions to the definite observable reality.

So this, put in a nutshell, is the character of the First Part of this treatise: it describes a logically possible branching off from the path which physics has set out at the beginning of the 20th century. The advantage of this new way is that locality and objectivity of the world are restored, and, at the

¹³ EPR stands for Einstein, Podolsky und Rosen, who put this scenario up for discussion. (*Can quantum-mechanical description of physical reality be considered complete?* Phys. Rev. 47, 777, 1935.)

¹⁴ Planck's description of the blackbody radiation relates only to the discreteness of the energy absorption of resonators brought into the radiation field and not to the discreteness of the radiation itself. Planck did initially not agree to Einstein's assumption of *light particles* in his description of the Photoelectric Effect.

same time, matters which so far used to be unexplained and indeed inexplicable, assume a simple, comprehensible form, and all paradoxes disappear.

Independently from each other, all explanations and conclusions of the first part are pointing decisively to *waves* as basis of the physical description of the world, whereas it proves impossible to understand *particles* as elementary entities. With this it becomes clear that the fundament of physics – that, as mentioned at the beginning, everything which exists and which occurs can be traced back to the motion of elementary entities which interact with each other – must be replaced by another principle.

In the Second Part, the structure of reality that follows from these preconditions is outlined, whereby however it is not necessary to draw on the conclusions of the First Part. Indeed they are verified, however the new reasoning is completely independent from the First Part – and, moreover, completely independent of all hitherto existing physics.

Thus it is truly a new start. So it is all the more surprising that, from this totally different starting point, already after a few logical steps yet again the great physical theories come in sight: The theories of special and of general relativity and quantum theory. However this applies only to the formal part of the theories – the interpretation changes fundamentally.

Without doubt you are asking yourselves in what a wondrous way these absurd sounding promises should be fulfilled. By what kind of method could that be achieved?

The method is, to say it in the shortest way, the derivation of physics from metaphysics.

At first, the difference between *reality* and *description of reality* is determined. From this follows a proposition which, brought into the form of an equation, seems to be qualified as the fundamental equation of physics. Among others, gravitation, electromagnetism and atomic structure follow almost directly, only with the aid of some additional geometric assumptions, from this equation which is of astounding simplicity.

Indeed I myself was quite surprised by the whole procedure. Though the metaphysical part of the train of thoughts seemed compelling to me, I would have regarded it as interesting at best, but basically as insignificant, if the path to physics was not so short.

The Second Part finishes with some consequences for cosmology that ensue from the hitherto achieved results.

In the Third Part, the three areas of reality,¹⁵ whose mutual relationship is completely unknown at present, are united by a single concept:

1. The area of the physical: the material world.
2. The area of the mental: the world of consciousness, of thoughts, feelings and perceptions.
3. The area of the discoveries and creations of mind, which also the Platonic world of mathematics and the laws of nature is a part of.

At the beginning the question of the connection between the material world and the law which it obeys is answered, and also the questions where this law comes from and how it can be justified, as it is not simply presented to us by nature but has to be discovered. These questions can be cleared up by resorting to realizations of the Second Part.

In order to unite the world of the mental states – the realm of mind – and the material world, a concept of existence must be developed that provides an understanding of the essential changing of the evolving being. This is achieved in two steps:

First it is demonstrated that causality is not only working "bottom-up" but reversely also "top-down". Accordingly complex, composite aggregates become *autonomous entities*. Mental states are such entities. In this way the self-dependency and dominance of the mind as well as the existence of free will can be substantiated.

A necessary precondition for the possibility of the existence of causality "top-down" is the change of the physical paradigm performed in the Second Part.

Finally, a short philosophical excursus leads to a complete concept of being, which comprises physical being *and* mental being *as quale*. Thus mind and matter are, at long last, united within a single model of reality that is built upon an (adjusted) scientific fundament.

The basis for the systematical clearing up of the relationship between the material world and the world of the discoveries and creations of mind has also been created in the Second Part: the difference between *objects of reality* and *objects of a description system* determined at the beginning of this part

¹⁵ Here I follow the classification of Karl Popper, in particular his discrimination between a mental state as a feeling and as part of a logical structure, i.e. between the emotional content and the information content of any mental state. (I will assign the term "quale" to the mental state *as a whole*.)

serves as demarcation criterion and permits to understand the ontological status of the entities of the two worlds.

So much for the preview of the following lines of thought. I shall close with a loose sequence of comments.

On the kind of transformation of the worldview. Every culture has its own explanation of the world. However our own, physical explanation differs from all other ones by the fact that culture-specific and therefore replaceable elements have been largely eliminated and substituted by verifiable hypotheses. The accuracy of the congruence with the observed reality is so high that contemporary physical theories cannot simply be replaced by other ones.

So how should such a fundamental change as just announced be possible?

The answer is that the conceptual fundament of the theories is by far less stable than their formal part. Already at the beginning, I mentioned as an example the change from Newton's theory of gravitation to that of Einstein. Formally, Newton's theory is an approximation of Einstein's – in this regard, therefore, the two theories are similar to each other. But with respect to the basic concepts, they are completely different. The concept of attraction between masses is replaced by the concept of curvature of space-time.

The change that I propose alters the conceptual fundament of physics as a whole, in such a way that all physical concepts are reduced to one single concept and all physical circumstances are reduced to one single circumstance. With this, the interpretation of the theories changes essentially; however the formal part remains unchanged or at least almost unchanged.

On the method. In most cases, I shall neither pursue any existing argumentation strategies nor relate to them. Therefore it is superfluous to discuss the relationship between my point of view and other ones.

I try to solve every problem with as few resources and tools as possible. This requires liberating the respective scenarios from their historically developed context and rebuilding their logical structure. Only in this way the wrong conceptual paths, which physics and philosophy have progressed along and which have rigidified themselves to such an extent that alternatives seem completely unthinkable, can be avoided.

As a matter of fact, the problems the solution of which we are targeting here are exactly the ones that could *not* be solved with the standard methods. Thus their unsolvability is to a certain extent also a language problem. Accordingly I shall analyze these problems in general not by the terminology of the

associated field. When I use philosophical concepts – for instance the concepts *substance* and *accident* in the Second Part and in the Third Part – I use them at first in a simpler and later also in a different sense as usual. It is absolutely imperative to read them as they are defined and used here and to leave behind all differentiations that they have undergone in the course of the centuries. Only in this way, by exactly this kind of application, they are powerful enough to solve the problems which will be described and analyzed by them.¹⁶

In the area of physics, it will turn out that in some cases – e.g. in the explanation what *actually* happens at the double slit experiment – the everyday language, augmented by a bit of mathematics, is more appropriate to solve the hitherto existing interpretation problems than the mathematical formalism. The reason for this is that the mathematical formalism has more and more assumed a separate existence and has absorbed the reality that was the reason for its creation. In order to renew the tension between this reality and the formalism, it is therefore inevitable to step out of the formalism and refer to the reality that lies behind it.

Reality and formalism. Reality is not a mathematical formalism. The idea, a planet would *calculate* its path is simply absurd; whatever happens is surely not a consequence of calculation.

But then – what does *actually* happen? *How* does it happen? *Why* does it happen? *By which circumstances* is a planet led on its path? And in general: *In which way* does the future evolve from the present, if it is not *calculated*?

These are the questions about the reality that lies "behind the formalism". They have almost completely disappeared from the awareness of the physicists. The answers to these questions, however, represent the actual goal of the search for knowledge of nature, and therefore they will be in the center of the following considerations.

On communication problems. Surely, the main problem is that hypotheses which relate to the conceptual foundations of physics, are at first unexplainable. For what means *explaining*? It means relating something unknown to something already known. However if just that which is already known is put into question, then this path to understanding, i.e. by explanation, is at first hardly

¹⁶ It was with some reluctance that I decided to apply such historically grown concepts. However the only alternative, that is to invent new concepts, seemed even more problematic to me, especially because of the anyway existing congruities between my definitions and the usual meanings. After all it could be argued that, ultimately, they mean yet the same. Therefore I preferred to adopt the established concepts. At first it may seem that I just usurped them, but at the end, in achieving the desired explanations, it will turn out that it was a justified acquisition.

possible. If exactly the known *explanantes* are indeed affected by the intended changes, then understanding presupposes to suspend – at least on trial – even the basis of the usual view.

However, at the end the conversion of the whole interpretation network is a question of immediate *seeing* – suddenly the perception toggles into a different state, as in an optical illusion, and the new shape becomes visible.

But enough with the preliminaries. Let us now proceed to the real thing.