Reflections about God or the World through the eyes of a physicist

Edward G. Timoshenko *

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Abstract

This is the author's English translation of the article on the scientific view of metaphysics of the Universe published in Russian in 1991 in an interdisciplinary journal of the Academy of Sciences of the former USSR just before the dissolution. At the time the author was completing his theoretical physics M.Sc thesis on the problem of confinement in Quantum Chromodynamics at the Department of Physics of Moscow State University. This paper explores the concept of God's grand design from a scientific logical perspective. It is argued that this idea naturally arises by considering the closure of a hierarchy of physical theories. The structure of the major scientific theories is outlined and how they relate to each other is considered. The process of scientific discovery is scrutinised and some historical background of the twentieth century physics is discussed. The categories theory approach to the ultimate unifying theory that encompasses all other scientific theories is proposed as a valid mathematical framework to think about the God's design manifesting in the physical World.

The combined use of two distant words 'God' and 'physics' may give the reader the wrong impression of the content of these notes and may even appear to some as a semantic pun. However, the present work has a very specific purpose, namely, to examine by means of structural analysis the

*Translated to English by the author from the ONC journal publication [1] by E.G. Timoshenko (C) 1991. E-mail: Ed@EdTim.live. Web: https://www.EdTim.live/science

borderland between established scientific truth and the hidden continuum of the unknowable — the prerogative of religion. Since science has a limited amount of information, minus it, the rest of the world is rationalised by alternative methods. If to reason in a similar way, our specific purpose here can be reformulated in another way — we shall try to consider the Universe and Man's place in it as they are seen by a theoretical physicist working in the field of quantum field theory. The reader unsophisticated in our science should not be confused by the special terms that will be encountered from time to time. As a rule, their exact meaning is not too important for the subsequent logical constructions.

I

It is rather difficult to write on such topics. The object of study is so fragile that one fears to destroy it by careless handling. We often have a strong aversion to metaphysical speculations claiming to be scientific. They are especially unconvincing when an attempt is made to 'sweep under the carpet' the difficulties of this or that theory by reference to the presence of some otherworldly component of the physical process. Unsolicited mysticism, in my opinion, is far from both real science and true religion.

Let us turn to the formal scheme of the physical approach to the process of discovery. Its first link consists in the identification of real phenomena by abstract mathematical symbols. A physical theory makes it possible to deal with the latter in a non-contradictory manner, producing conclusions that can be interpreted in terms of experiment. Comparison with experimental data is then used to test theoretical constructs against reality. All the stages of the scheme work and make sense if only the 'rules of the game' derived from the internal logic of the theory are observed. Summarising, we will call this requirement the self–consistency of physical science.

Contrary to popular beliefs, the scientific method of cognition is to some extent conservative. The physicist always tries to explain phenomena within the framework of an accepted theory and, only after being completely convinced of its unsuitability for a given phenomenon, introduces a new hypothesis. It can be said, therefore, that scientific description is carried out by minimal means. It follows from this property of science that it can develop either evolutionarily within a fixed theory or abruptly, when general ideas change. Revolutionary upheavals, in fact, mean not just the rejection of previous views, but the indication of the limits of their applicability to the real world. A new truth makes it possible to cross an old threshold and deepen the understanding of nature.

As often happens, the conclusions that a scientist reaches in the process of work are more general than the immediate motives that motivated him to work. Does not the modern level of natural science lead to concepts unusual for the physical paradigm? Let's try to consider the hypothesis of God in the framework of structure theory as related to the closure of the hierarchy of the world.

Of course, some colleagues will challenge the necessity of introducing transcendental terms into physical theory, pointing to professional ethics. I want to make my position clear. It is not my intention to address metaphysical questions like whether or not God exists. It is more modest — to propose a way of rational description in the traditions of modern physics and mathematics of the general situation regardless of the concrete answer to the question about the existence of God. It is quite clear that the answer will largely depend on our definition of the concept of God.

Suppose we stand on purely materialistic positions. Then it is asserted that there is no God. On the contrary, if we are Christians, there is no doubt for us that God is revealed in Jesus Christ. A person chooses between these two beliefs (i.e. positions that cannot be verified in principle) and a large number of other views on his personal level, guided by some Logic. The believer, accepting religious tenets, rests on the truth sanctified by centuries and generations of ancestors. A man who is inclined to trust rather in himself than in others is not likely to be satisfied with such a justification. In the most expressive form we find the atheistic position in F. Nietzsche's 'Der Antichrist', who tries to shake the foundations of religion with the blows of his criticism [2]. In 'Also sprach Zarathustra', a kind of bible of Nietzscheanism, he gives instead of Christ the image of the superman [2]. But Nietzsche cannot go further than the destruction of existing foundations and the declaration of an unreal ideal. He does not offer specific prescriptions, as this would contradict his idea that man himself must become the creator of life, passing through the stage of the superman, leading from man upwards. This path is too dangerous, and we do not know if anyone can take it.

Existential philosophy, on the contrary, speaks of man's abandonment in a world alien to him and his inability to find his true self. The theme of absurdity becomes central to A. Camus, who depicted the absurdity of existence with a striking artistic sense in his essay 'Le Mythe de Sisyphe' [3]. But is the abyss in which Man finds himself so hopeless?

Let us try to understand the reasons for the sense of absurdity that befell not the worst representatives of humanity. One of them lies in the fact that these people were clever enough to recognise the inadequacy of the socially accepted views. They rejected old values without gaining anything in return. In different terms, the sense of the absurd is the vertigo of being able to look at the world from a myriad of different logics, when the ground falls away from under one's feet, due to the absence of one singled out true logic of life. A return to religion cannot satisfy these people, for the worm of doubt has eaten away at their faith, and the outward forms of religion seem ridiculous creations of a sick imagination.

Science does not claim to be the saviour of mankind, the question of the meaning of life is not its question. The field of competence of science does not extend that far. However, the scientific method proves useful even here. The apparatus of modern natural scientific theory is very complex. A university education can only bring us closer to understanding it. The complexity of the problems under study, as advanced as they are today, does not allow them to be analysed by more elementary means. The widespread belief that one can learn the workings of nature from popular books is based on a misconception. Only a few professionals have information about the fundamental structure of matter, being specialists in their fields. The picture of the world, which is formed in the researcher's mind, is based primarily on the already existing framework of scientific knowledge. On that, the scientist erects fragments of his own creation.

Where does confidence in the strength of the whole building come from? In answering this question, evidence is found in the intrinsic non contradictability of the complete scheme and the verifiability of specific results. Under certain circumstances, theory has predictive power — this is one of its most surprising properties. Through the possibility of experimental verification, theoretical constructs acquire the status of a description of reality. However, I am not going to take a dogmatic–materialist position here. The situation with the experiment looks much more complicated than declared above. The whole procedure of verification as central to science therefore deserves a more detailed discussion.

II

A theory, in order to have a sufficiently nontrivial structure adequate to the complexity of nature, inevitably uses a large number of abstract concepts and mathematical objects. Not all of them have a direct relation to reality. In the most general form it is necessary to distinguish two classes of objects: observables[1] $\mathfrak{A}$ and and states $\mathfrak{G}$ of the system under study. The only thing that a theorist can say about a given system is the value of some observable A from class $\mathfrak{A}$ in a certain state Φ of $\mathfrak{G}$, denoted by the sign (A, Φ). Now it is necessary to calculate theoretically those quantities (A, Φ), which characterise interesting properties of the system and, at the same time, can be measured in a rather simple experimental setup. Any experiment realises an unnatural state of nature and must therefore be carefully prepared. The machine is brought into an unstable state, similar to a cocked trigger. Then a process takes place in the physical system which, due to its interaction with the device, leads to the activation of an infinite chain of 'gates' at different levels of structures. Eventually, the instruments move to a new steady state and we record their readings.

It is clear that the experiment corresponds to the ideal model only approximately. The measurement result is therefore inaccurate and lies within a certain controllable error. The instrument itself introduces an unavoidable perturbation into the system in the process of the act of measurement.

The experiment has a natural requirement for repeatability. Its conditions must be reproducible, otherwise reliable results cannot be obtained.

All this together leads to a difficult problem. We must not forget a purely psychological circumstance: experiments are performed by living human beings who are prone to misconceptions and errors. We are entitled to distrust specific results or their interpretation. Therefore, the final step in the verification of a theory is the recognition of its truth by the scientific community, which has data from experiments performed by independent groups of researchers. This last point destroys the halo of a priori objectivity of theory based on the absolutisation of the functions of experimentation. The responsibility for the realism of a theory lies not with experience, but with scientists. The criteria of truth ultimately turn out to be the usual criteria of human logic, not something specific to science. Only the method, i.e. the 'rules of the game', is specific.

[1] See the list of all notations in the Addendum

If one were to pursue this line of reasoning, one would have to question the ability of science to produce its own metaphysics, i.e. to reach conclusions about the global structure of the world on the basis of a finite number of scientific results. Science can do this no more successfully than human consciousness in general. Worse, it is much more difficult for it to make such a generalisation because it is encumbered by 'rules of the game' that may turn out to be inadequate. On the other hand, we know that all the most valuable results in the scientific field are related precisely to its ability to be rigorous, i.e. to determine uniquely the truth of concepts — an achievement to be attributed to method.

My idea is to apply the scientific method to metaphysics and metalogic without trying to pass it off as a method for solving specific problems for which it is of little use. Science can move forward because it is able to isolate simple functional relationships, analyse them, and then synthesise more complex facts from the individual building blocks. The relevant approach is called structural analysis. Note that it is not diminishable to reductionism. It is easiest to apply it directly to the set of physical theories Ξ. This is the only class of objects known to us in detail. Assuming that physical theories correspond in some sense to an objectively existing reality, the conclusions we have drawn for theories apply with a great deal of caution to the world. In fact, here I have given a general formulation of the traditional way of doing things in physics.

III

Let us now turn to a study of the class of physical theories Ξ. Science is never in a static state. History gives examples of the formation, development, triumph of theories, then a period of their ageing and replacement by new ones. A former theory must be derived from a new and more general one as a special case. Thus, for example, the relativistic dynamics of the Special Theory of Relativity passes into classical dynamics in the limit when the speed of light tends to infinity. As applied to quantum mechanics, the problem of the limit transition to the classics has not yet been satisfactorily solved. The difficulty lies in describing measurement without appealing to the notion of a classical instrument. There is a great deal of serious work on this subject, as well as speculation based on nothing. As a consequence of physicists' dissatisfaction, there are a dozen interpretations of quantum mechanics, ranging from the orthodox Copenhagen interpretation to the many-worlds interpretation based on the model proposed by Hugh Everett [4]. I will refrain from discussing the problem among non-specialists, although I do have my own opinion on this matter.

Let us consider a set of modern theories in a fixed moment of the evolution of scientific knowledge. We will limit ourselves to those phenomena that we have managed to understand within the framework of these theories, neglecting the phenomena that require a new approach. We shall see that these theories form a natural hierarchy. We will say that theory A is of a higher level than B if the concepts of theory B are reduced to the more fundamental concepts of theory A. (In contrast to the the ideology of reductionism, which attempts to reduce the complex to the primitive, here, on the contrary, the properties of simple forms are deduced from the arrangement of the complex forms encompassing them). The phenomena described in theory B must be described in theory A as well. However, it almost always turns out that it is technically impossible to carry out such a description in terms of more fundamental objects because of colossal mathematical difficulties. Figuratively speaking, we can say that the human brain is too weak to see the distant consequences of general statements.

The simplification of equations in the lower level theory B is achieved due to the fact that it describes reality in less detail. In practice, the reduction of one theory to another is shown by constructing an approximation of A by theory B: In typical examples, it is necessary to consider the limiting transition when, in a given region of system parameters, the suppressed effects can be neglected compared to the leading ones. In order to study the relations between two theories, it is necessary to reformulate them in the same language beforehand.

The world cognised by physics, as can be seen, is displayed in the consciousness of hierarchies of theories. This structure is so fundamental that it can be defined mathematically.

Any theory A from the set Ξ specifies the structural level of knowledge as well as the logic, i.e. it establishes relations (truths, orderings, etc.) between its objects. From the point of view of mathematics, a theory A forms a category [5](hereafter the word is used in the narrow algebraic sense). A category A is a triplet $(A, M(A), \Phi(A))$, where $A$is a class of elements called category objects, $M(A)$ is a class of other elements called morphisms or arrows of the category, and Φ(A) is a mapping that maps any pair of objects α, β from A to a set of morphisms $M(\alpha, \beta)$ from $M(A)$, each of which we represent by the sign $\overrightarrow{\alpha\beta}$ and call an arrow from α to β. The following three properties are required:

1. A multiplication of arrows is given. i.e. a mapping from $M(\alpha, \beta)$, $M(\beta, \gamma)$ to $M(\alpha, \gamma)$ mapping any two arrows $\overrightarrow{\alpha\beta}$ and $\overrightarrow{\beta\gamma}$ to some arrow $\overrightarrow{\alpha\gamma} = \overrightarrow{\alpha\beta} \bullet \overrightarrow{\beta\gamma}$.

2. The multiplication is associative, i. e. $(\overrightarrow{\alpha\beta} \bullet \overrightarrow{\beta\gamma}) \bullet \overrightarrow{\gamma\delta} = \overrightarrow{\alpha\beta} \bullet (\overrightarrow{\beta\gamma} \bullet \overrightarrow{\gamma\delta})$.

3. For any α of A in the class $M(\alpha, \alpha)$ there is a single arrow element $\overrightarrow{\mathbb{1}_\alpha}$ $(= \overrightarrow{\alpha\alpha})$ called the unit in a with properties: $\overrightarrow{\alpha\beta} \bullet \overrightarrow{\mathbb{1}_\beta} = \overrightarrow{\alpha\beta}$, $\overrightarrow{\mathbb{1}_\alpha} \bullet \overrightarrow{\alpha\beta} = \overrightarrow{\alpha\beta}$.

The arrows are the relationships between the objects that define the logic. In order to compare two theories (logics), it is necessary to construct a mapping of one category into the other, called a functor. The functor $\mathfrak{F}$ from category A in the category B is a a pair of mappings $\mathfrak{F}$: $A \to B$, $M(A) \to M(B)$, mapping any object α from A to some object $\mathfrak{F}(\alpha)$ of B, and to an arrow $\overrightarrow{\alpha\beta}$ in $M(A)$ a certain arrow $\mathfrak{F}(\overrightarrow{\alpha\beta})$ in $M(B)$ in such that:

1. $\mathfrak{F}(\overrightarrow{\mathbb{1}_\alpha}) = \overrightarrow{\mathbb{1}}_{\mathfrak{F}(\alpha)}$i.e., the unit arrow goes to the unit arrow.
2. $\mathfrak{F}(\overrightarrow{\alpha\beta} \bullet \overrightarrow{\beta\gamma}) = \mathfrak{F}(\overrightarrow{\alpha\beta}) \bullet \mathfrak{F}(\overrightarrow{\beta\gamma})$.

The dualisation operation $*$ is also defined, which reverses the 'direction' of all arrows. Functors have associative multiplication, as do morphisms. It is easy to construct a category of all functors from the category A to B called $\mathfrak{F}(A, B)$. The morphisms in it are the arrows $\overrightarrow{\Psi_\alpha}$ of $M(\mathfrak{F}_1(\alpha), \mathfrak{F}_2(\alpha))$ for any α of A. Here $\mathfrak{F}_1$ and $\mathfrak{F}_2$ are functors in $\mathfrak{F}(A, B)$ such that the diagram shown in Fig. 1 is commutative. Readers wishing to familiarise themselves with the theory of categories further we may refer, for example, to the monograph by R. Goldblatt [5].

$$\begin{array}{ccc}
\mathfrak{F}_1(\alpha) & \xrightarrow{\overrightarrow{\Psi_\alpha}} & \mathfrak{F}_2(\alpha) \\
{\scriptstyle \mathfrak{F}_1(\overrightarrow{\alpha\beta})}\big\downarrow & & \big\downarrow{\scriptstyle \mathfrak{F}_2(\overrightarrow{\alpha\beta})} \\
\mathfrak{F}_1(\beta) & \xrightarrow{\overrightarrow{\Psi_\beta}} & \mathfrak{F}_2(\beta)
\end{array}$$

Fig. 1. Morphisms of functors

The commutative diagram should be understood as follows. Mappings from a point $\mathfrak{F}_1(\alpha)$ to a point $\mathfrak{F}_2(\beta)$ by to two different paths $\overrightarrow{\Psi_\alpha}$, $\mathfrak{F}_2(\overrightarrow{\alpha\beta})$ and $\mathfrak{F}_1(\overrightarrow{\alpha\beta})$, $\overrightarrow{\Psi_\beta}$ are equal. In the composition language $\circ$ this is written as: $\overrightarrow{\Psi_\beta} \circ \mathfrak{F}_1(\overrightarrow{\alpha\beta}) = \mathfrak{F}_2(\overrightarrow{\alpha\beta}) \circ \overrightarrow{\Psi_\alpha}$ (the composition of mappings is read from right to left, and the multiplication of arrows is read from left to right).

Two elements α' and α'' belonging to category A are isomorphic $\alpha' \sim \alpha''$ if there exist such arrows $\overrightarrow{f}$ in $M(\alpha', \alpha'')$, $\overrightarrow{g}$ in $M(\alpha'', \alpha')$ so that $\overrightarrow{f} \bullet \overrightarrow{g} =$

$\overrightarrow{\mathbb{1}_{\alpha'}}$, $\overrightarrow{g} \bullet \overrightarrow{f} = \overrightarrow{\mathbb{1}_{\alpha''}}$.

Two categories A and B are equivalent if there exist functors $\mathfrak{F}\colon A \to B$ and $\mathfrak{G}\colon B \to A$ such that the composition $\mathfrak{G} \circ \mathfrak{F} \sim \mathrm{id}_A$, $\mathfrak{F} \circ \mathfrak{G} \sim \mathrm{id}_B$, i.e., are isomorphic to the identity functors $A \overset{\mathrm{id}}{\to} A$ and $B \overset{\mathrm{id}}{\to} B$ in the categories $\mathfrak{F}(A, A)$ and $\mathfrak{F}(B, B)$, respectively.

Consider a set of theories Ξ. Each element A in Ξ is a category. Let us define in Ξ the relation of reducibility. The category B is reduced to A (we write $B \Rightarrow A$) if there exists a single functor $\mathfrak{F}\colon A \to B$ and a set of functors $\mathfrak{G}_a :\ B \to A$ such that the composition $\mathfrak{F} \circ \mathfrak{G}_a \sim \mathrm{id}_B$. It can be seen that $A \Rightarrow B$ and $B \Rightarrow A$ then and only then when A is equivalent to B ($A \Leftrightarrow B$). Then the set Ξ with the reduction relation given on it as arrows forms a category. If C is not reducible to D, then $M(C, D)$ does not contain arrows. A category introduced by means of Ξ is called a hierarchy Δ if, for any element A belonging to Δ, there exists an element B such that at least one of the classes $M(A, B)$, $M(B, A)$ contains arrows.

Consider a subcategory $\Delta(A)$ such that its object class $\Xi(A)$ consists of all B where there exist arrows in at least one of the classes $M(A, B)$, $M(B, A)$. Such a category $\Delta(A)$ we will call a branch of the hierarchy. The top element of the branch $\Delta(E)$ is the element E, in which all $M(F, E)$ for any F of $\Delta(E)$ contain arrows, and all $M(E, F)$, $F \neq E$ does not contain any arrows.

Let us now introduce an important definition of the universal repulsive element α_0 of an arbitrary category A. By this we will call an object α_0 such that all $(M(\alpha_0, B))* = M(B, \alpha_0)$ for β of A contain exactly one arrow each. It is a valid theorem to state that if there exists a universal repulsive element in a category A, then it is unique up to isomorphism. The presence of such an element in a category is a very strong and non-trivial property. The universal repulsive element of the hierarchy Δ, if it exists, we will call it the closure of the hierarchy $\mathfrak{G}$.

Closedness of hierarchy means that it contains only one branch with the top element $\mathfrak{G}$. In a general situation, there may be many branches, or a single branch may not have an upper element. The latter case is reduced to the basic case by using the completion operation. Completion is a functor from the category of all hierarchies to the category of closed hierarchies. As a morphism in the category of hierarchies the relation of reducibility is taken.

The result of the development of natural science was the construction of a hierarchy of theories. Initially it contained many disconnected branches, but then the unification of theories was encouraged to fill in the missing links and reduce the fragments to a single branch. This trend continues to this day.

In Fig. 2 we schematically depict the structural hierarchy in the modern physics at the time of writing (1991). Of course, it should not be interpreted too literally, as it only roughly shows the main connections between the different areas of the theory. The dotted lines represent the division between areas that are almost non-contiguous presently.

It is possible that the ideal dream of theorists about the Great Unification will be realised one day in the future. Then the completion will provide an unambiguously defined closure of the hierarchy $\mathfrak{G}$, which is unique (isomorphism reduces to different equivalent descriptions of the same thing). Category $\mathfrak{G}$ has all the properties that allows it to be identified with the God's design of the World. Namely, it is the only element in Δ from which all other categories are synthesised (synthesis is the arrow dual to reduction).

We have thus obtained an invariant definition that does not depend on the arbitrariness of the choice of logic, since we initially included in consideration their set Ξ. Naturally, the question of the existence of the universal element remains open. It may not exist if the hierarchy contains more than one branch, but this would look too unaesthetic from the point of view of modern physics, which has unified many phenomena. If it is possible to construct a unique branch of the hierarchy, then even in the case when this branch has no upper element (i.e. a general theory cannot be achieved, but it can be advanced step by step), the universal element still exists as a closure of the hierarchy when the meta-logic is augmented.

The natural desire of the researcher is to establish a connection between the logical structure in the consciousness given above and the actual arrangement of the world. We are clearly aware that the world is far more complex than our ideas about it, and all the concepts that are used to describe it actually make sense only to humans, like the word 'meaning' itself.

The development of science would be impossible without some general assumptions that are rarely formulated explicitly and cannot be verified due to human limitations. Let us formulate such a statement as a postulate, preceding it with some heuristic judgements.

Categories have been interpreted as logical elements and morphisms as logical relations. However, a set of objects can be considered abstractly without attributing logical arrows to them. This is probably what we should do when we endeavour to describe the world. Morphisms reappear in the theory, but in a new and different way. They now describe processes, which in physics are called interactions.

Postulate: The real world is endowed with a structure, .i.e. it is a category (denote it $\mathfrak{W}$). The cognition of the world is a functor χ: $\mathfrak{W} \to \Delta$, which leads to the loss of some of the information about $\mathfrak{W}$. An inverse functor from Δ to $\mathfrak{W}$ such that a reduction can be defined therefore does not exist. The hierarchicality of Δ is related, in general, not to the nature of $\mathfrak{W}$, but to the nature of the functor χ. The universal element of the hierarchy need not exist outside the category Δ directly in $\mathfrak{W}$. It arises on triples of the form $(\mathfrak{W}, \Delta, \chi)$. *Thus, God appears in our consciousness as a result of knowledge of the world.*

IV

So far, we only discussed how the concept of the God's grand design of the world can be described. Let us now turn to the main topic of the article — how Man can comprehend it, fulfilling his supreme purpose. It is not possible to specify any particular way of doing this. Anyone has its own way. Because of the invariant character of $\mathfrak{G}$, it is not very important in which logic we work — scientific, philosophical, religious, etc. The only way to try approaching God is to communicate with Him in an irrational way whilst our logic is useless and we rely on feelings. It is not by chance the word 'communication' is used. Man can only perceive by humanising nature, i.e. by endowing it with our feelings and thoughts. God, as the most irrational of notions and transcendental to the creation, is therefore most difficult for our mental process to comprehend. From this perspective, one can see the reason why Christianity is widely recognised as a religion with a possibility of personal communion with God. However, there are other religions, and this is a highly sensitive subject that we may not dare to discuss.

This article is devoted to a different topic though: how God's manifestation can be found in pursuits of physics. This particular kind of human activity is not fundamentally different from any other. The humanisation of nature is even better visible in this discipline, because we attribute to it the properties of mathematical objects invented by us. The limits of the physical paradigm are clearly visible. It does not include very well the transitions between structural levels and does not include at all the levels above the most general at this point in the theory. It can, of course, be postulated that the theory of the highest current level (let us denote it $\mathfrak{T}$) can no longer be reduced. This volitional act limits the further cognisability of the world.

The answer to the question, why nature is such, is now uneditable — because it is so at the upper level $\mathfrak{T}$. To answer why the theory is the way it is, as Richard Feynman [6] pointed out, physicists will not answer, at best they would tell you that God chose the best of possibilities. This phrase was uttered in jest, but it contains quite a serious meaning. Physicists believe in the unity of the world, that the world is organised according to internally harmonious and universal laws. Their belief is reinforced by the experience of generalisation and unification of ideas as a result of the development of theories.

But like any faith it contains in itself edements of the irrational. We can say that it is inspired by an aesthetic feeling, reveling in the picture of the universe suddenly opened to the eye of the researcher. This feeling can be experienced in full measure only by a few lucky people. Such was Werner Heisenberg, one of the founders of Quantum Mechanics. This is how he described his state of mind when he was able to decipher atomic spectra and guess the quantum laws [7]: "At the first moment I was scared out of my wits. I had the feeling that I was looking through the surface of atomic phenomena to a foundation of astonishing inner beauty lying deep beneath, and I was almost dizzy at the thought that I could now trace the totality of the mathematical structures that nature had unfolded before me in the depths. I was so excited that I couldn't even think about sleeping."

A man of religion would call such an experience the result of Divine revelation.

We come to the central point. Science is composed primarily of individuals who create its foundation. Different researchers have their own understanding of the world. Such a work is always on the edge of their understanding, i.e. in the borderland. Through their work, the scientists gradually push back the horizon of what is known. I have already mentioned that old concepts can become contradictory when the horizon moves to the limits of a new structural level.

To better understand the situation in which a scientist discovering a new field finds himself, let us turn to Newton's *Mathematical Principles of Natural Philosophy (Philosophiae Naturalis Principia Mathematica)*, published [8] in 1687. This classic work was the first embodiment of physical theory, in the sense in which we understand it today, the 'Principia' became the basis of the worldview of physicists of the whole era of classical mechanics and the model on which subsequent theories were built. The extraordinary success of the Newton's work is linked to the universality and the naturalness of the concepts he used, which encapsulated the concentrated experience of mankind. Classical mechanics was so successful in its explanations of phenomena that it gave rise to its absolutisation. The abandonment of Newtonian mechanics was therefore very painful and required a radical breakdown of established ideas.

Issac Newton was a deeply religious man, but this is not very explicitly reflected in his book. The presentation of the Mechanics is extremely formalised. It is built on the foundations of the main concepts and axnomena. All conclusions are formalised in the form of theorems and corollaries. Although Newton discovered the calculus of infinitesimals, he uses no mathematical apparatus other than Euclidean geometry, which he probably regarded as a model of clarity and visualisation. The concept of God appears in Newtom only in the very last pages of the 'Principia'. It would seem that since it is not logically necessary and is excluded from the theory as superfluous, why did Newton need it at the end?

We cannot judge how Newton discovered his laws; they are given to us ready-made, packaged in axiomatics. It is impossible to say how these laws follow from experience, we can only verify their particular consequences. The acceptance of a theory inevitably presupposes an initial premise — the postulation of axioms. In taking this step, the researcher can never be sure of its correctness in advance, much less convince others of it. The process of selection itself is too complex to be traced in a rational way. To put it even more strongly, it is irrational by nature, like any creative endeavour. Coming to his postulates as a result of long hard work, analysing a large body of data, the scientist experiences a sense of illumination when he finally manages to perceive the hidden truth he has long sought. Newton, in my opinion, turned his eyes to God at the end of his major work in order to confirm the divine character of the laws given to him in the form of deductions, i.e., in modern philosophical terms, to emphasise that these laws do not reflect his arbitrariness, but the essence of the phenomena he had managed to encompass.

It is worth noting an important circumstance. In the scientist's mind there is no a priori division of spheres of life; they appear together, forming a peculiar whole. God, who plays a central role in the views of a believer, does not contradict but, on the contrary, organically complements his scientific knowledge, if he/she is also a physicist. To believe means not just to believe, but to trust these values as a guide. Therefore, religious faith fulfils a much more active function than science.

Albert Einstein willingly mentioned the Lord God [9], who has to do with the unchanging natural laws. He defined the presence of God as a sense of the central order of things. Nevertheless, this does not mean that he was a believer in a religion and recognised its tenets. The canons of a religious tradition are a concrete way of realising faith. The concept of God that Einstein spoke of is more universal. The mere recognition of him does not mean that one must accept the tenets of religion, which are a matter of the believer's free choice.

V

Let us now try to look at science not as an individual endeavour but as a social process. Both of these views allow us to analyse the phenomenon of science. Taken in isolation, they would lead too far, either into subjectivism or historical materialism. Neither view seems to reflect the true state of affairs. It is clear that science could not exist without individuals capable of looking at the world from their own unconventional perspective, and it is also clear that the emergence of modern science is linked to complex processes in society. Theoretical physics is very young, its age is conventionally counted from Newton's 'Principia'. Youth inspires expectations of longevity, but there is no evidence to support this assumption.

An in-depth analysis of the dynamics of science was conducted by the American physicist and mathematician, yet another Nobel laureate, Eugen Wigner [10]. We briefly summarise this as follows. Science is a large body of knowledge packaged in a compressed form. In modern physics, the degree of such compactification has reached a critical density. But this knowledge becomes knowledge in the true sense of the word, only if there are people who are able to freely possess any part of it, realising the impossibility of assimilating the entire stock. The focus of scientific research changes, according to Wigner, in two ways. A shift of the first kind is a change in priorities associated with the transition of knowledge to a higher structural level of the hierarchy.

Each time, the new concepts are deeper and contain in a sense, the old ones. The 20th century physics shows examples of avalanche-like shifts of the first kind: Classical Mechanics – Relativistic Mechanics – Quantum Mechanics – Relativistic Quantum Field Theory (see also Fig. 2). The period of revolutions in physics was followed by a period of stabilisation. In the fast race, many aspects of the new were not understood. They were so unexplored and far-reaching that they required a thorough study by subsequent generations of physicists. The situation is the same now. Further progress is hampered by the fact that to verify a number of modern theories requires colossal energies, which cannot be not only created in the laboratory, but also cannot be found anywhere realised in the Universe. A number of specialists have suggested that the only arena in which the events described by the Grand Unification theories could play out could only be the early Universe, i.e. what it was in the extremely short period after the Big Bang.

In this regard, the possibility of a shift of the second kind becomes real. The difficulties increase exponentially as we move upwards. They mean that a new researcher who wants to work at the cutting edge must first wade through hundreds, if not more, of original papers. The human brain is too limited to encompass so much knowledge. This weakness of mind, together with the inevitable decline in interest, are the preconditions for a second kind of shift. The answer to the question about the adequacy of the N-th level is postponed for an indefinite period of time, probably much longer than the time of existence of our civilisation. This may lead to physical science as such ceasing to be the basis of world knowledge and taking a secondary role alongside other ways of knowing. My present field of interest, high-energy physics, shows the approach to the limit most vividly. The slightest experimental advances in the discovery of new elementary particles require the construction of ever more expensive and enormous accelerators. (The accelerator under construction in this country in Protvino is planned to have a vacuum ring length of about 20 kilometres and there are further plans for CERN and elsewhere).

The euphoria of previous years gave reason to believe that mankind is steadily moving towards progress and has no boundaries in the knowledge of the world. Now such a position seems overly optimistic. A period of upswing is followed by saturation and decline. The question arises, what will occupy the minds and time of researchers in the future, if not physical sciences? First of all, biology and psychology fields come to mind. These sciences are still in a period of growth and will not face the challenges of maturity any time soon. For too long we have been fascinated by the idea of happiness based on material well-being, the omnipotence of man manipulating the forces of nature at will, but we do not know very well what Man is.

A turn to history will immediately show us that this was not always the case. It was man who was at the centre of the universe in past historical epochs. Religion has been and remains the basis of this world order. No, it has not been neglected in a world of scientific revolutions, for man has always remained himself. The finite nature of life does not allow any of us to entertain the idea that science will ever be able to unravel the meaning of our existence. We want to know it now, while we live. It is peculiar to people - in everything to search for sense, and first of all in the life. And science itself should not be seen as an end in itself, but only as a way of moving towards an answer to a basic question. Wolfgang Pauli, the greatest physicist of the 10th century, said [11]: 'In the future, when thinking about the order of the universe, we should stick to the middle, as outlined, for example, in Bohr's Complementarity Principle.'

A science based on this way of thinking will not only be more tolerant of the various forms of religion, but will perhaps be able to consider the whole more fully and enrich the world of values. Pauli makes the important point that scientific knowledge is not opposed to religious knowledge, but is complementary to it. These two ways of thinking, in spite of their differences, only together make it possible to adequately describe the world open to the Man's gaze.

References

[1] Journal (ONC): Social Sciences and Contemporaneousness (Moscow), Obshchestvennye Nauki i Sovremennost' (Moskva).
Article: Reflections about God or the World through a physicist's eyes.
Author: E.G. Timoshenko.
Year: 1991. Volume: 2. Pages: 119-130. Publisher: Academy of Sciences USSR. Place of publication: Moscow. ISSN: 01323458.
Copyright owner: E.G. Timoshenko
Web site: https://www.EdTim.live/science

[2] Friedrich Nietzsche, *Also sprach Zarathustra; Der Antichrist* [1895] ISBN 9783937872735.

[3] Albert Camus, *Le Mythe de Sisyphe* [1942] ISBN 2070719669.

[4] H. Everett, J. A. Wheeler, B. S. DeWitt, L. N. Cooper, L. N., D. Van Vechten, N. Graham, *The Many Worlds Interpretation of Quantum Mechanics* (B. S. DeWitt & N. Graham, Eds.). (1973) Princeton University Press. ISBN 9781400868056.

[5] Robert Goldblatt, *Topoi: The Categorial Analysis of Logic.* Studies in logic and the foundations of mathematics. [1979] Vol. 94. (2006) Dover. ISBN 9780486450261.

[6] Richard Feynman, *Feynman Lectures on Physics.* Basic Books. ISBN 9780465023820; R. Leighton, *Surely you're Joking Mr Feynman* (1992) ISBN 978-0099173311.

[7] Werner Heisenberg, *Physics and Beyond: Encounters and Conversations.* (1971) World Perspectives Vol. 42. Trans. by A. J. Pomerans, New York: Harper & Row. ISBN 9780049250086.

[8] Isaac Newton, *Mathematical Principles of Natural Philosophy: Philosophiae Naturalis Principia Mathematica* [1686-7] (2018) ISBN9781722202071.

[9] Albert Einstein, *The Ultimate Quotable Einstein.* Calaprice, Alice (ed.) Princeton University (2010) ISBN9781400835966.

[10] E. P. Wigner, *Group Theory and its Application to the Quantum Mechanics of Atomic Spectra* (1959) New York: Academic Press. ISBN 9780127505503.

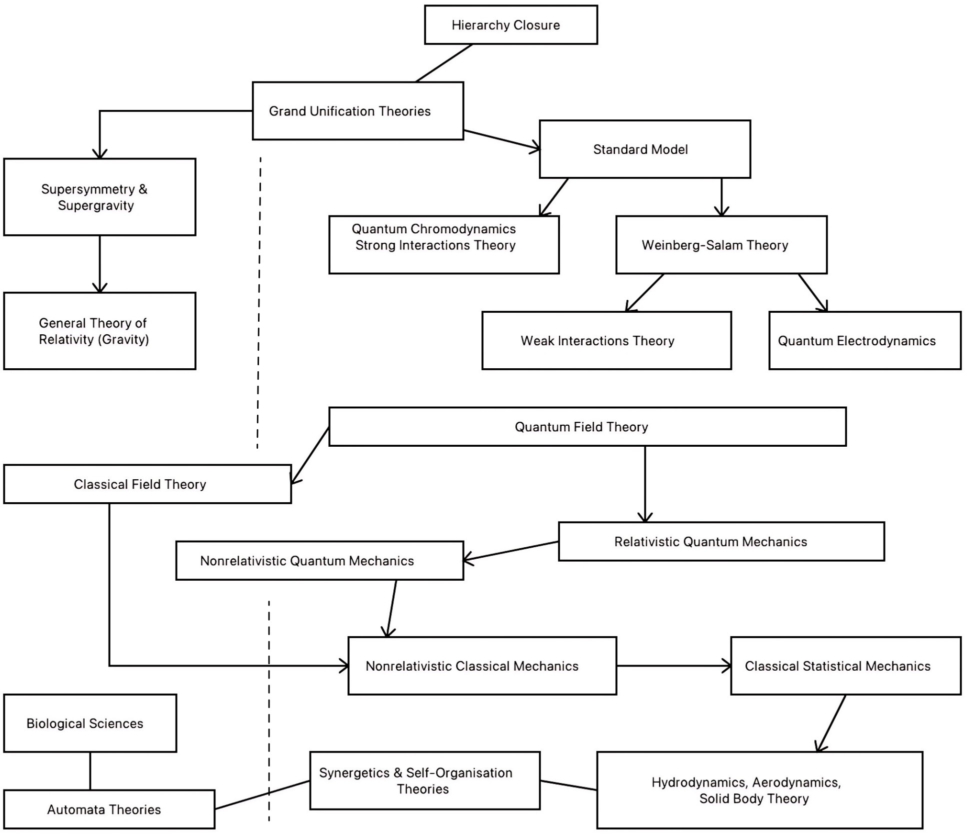
[11] Wolfgang Pauli, *Writings on Physics and Philosophy* ISBN 9783540568599.

Note: References are given in the English and the original languages in the modern printed editions at the time of the article translation.

Fig. 2. Schematic depiction of the structural hierarchy in physics of 1991.

Addendum
List of main notations

$\mathfrak{A}$ - observables of the system;
$\mathfrak{S}$ - states of the system;
(A, Φ) - mean value of the observable A in the state Φ;
Ξ - class of theories;
$(A, M(A), \Phi(A))$ - category of A;
$A, B.C, D, E, F$ - designation of categories;
$\alpha, \beta, \gamma, \delta$ - objects in a category;
$\overrightarrow{\alpha\beta}, \overrightarrow{\gamma\delta}$, - morphisms (arrows), also $\overrightarrow{\Psi_\alpha}$, $\overrightarrow{f}$, $\overrightarrow{g}$;
$\mathfrak{F}$,$\mathfrak{G}$ - designation of functors;
$A \stackrel{\text{id}}{\to} A$ -id - identity functor;
$\alpha' \sim \alpha''$ - isomorphism of objects;
$B \Rightarrow A$ - reduction of categories;
$A \Leftrightarrow B$ - equivalence of categories;
Δ - hierarchy of categories;
$\mathfrak{G}$ - closure of the hierarchy;
$\mathfrak{W}$ - world category;
χ - functor of cognition;
$\mathfrak{T}$ - highest level theory (for the moment);
$\circ$ - composition of functors (read right to left);
$\bullet$ - multiplication of arrows (read left to right).



Hierarchy Closure
Grand Unification Theories
Supersymmetry & Supergravity
Standard Model
Quantum Chromodynamics Strong Interactions Theory
Weinberg-Salam Theory
General Theory of Relativity (Gravity)
Weak Interactions Theory
Quantum Electrodynamics
Quantum Field Theory
Classical Field Theory
Relativistic Quantum Mechanics
Nonrelativistic Quantum Mechanics
Nonrelativistic Classical Mechanics
Classical Statistical Mechanics
Biological Sciences
Synergetics & Self-Organisation Theories
Hydrodynamics, Aerodynamics, Solid Body Theory
Automata Theories