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Nature of Some Conceptual Problems in Geometry and in the Particle Dynamics

By Yuri A. Rylov
Russian Academy of Sciences

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NATUREOFSOMECONCEPTUALPROBLEMSINGEOMETRYANDINTHEPARTICLEDYNAMICS

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Nature of Some Conceptual Problems in Geometry and in the Particle Dynamics

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Abstract- The particle dynamics conception (mathematical formalism) changes rather rare in the process of the particle dynamics development. It connected with associative delusions in the existing dynamics conception and with the logical reloading which is a means of the associative delusion overcoming. Influence of associative delusions (AD) onto development of physics and mathematics is investigated. The associative delusion (AD) means a mistake, appearing from incorrect associations, when a property of one object is attributed to another one. Examples of most ancient delusions are: (1) connection of the gravitation field direction with a preferred direction in space (instead of the direction to the Earth center), that had lead to the antipode paradox, (2) statement that the Earth (not the Sun) is a center of the planetary system, that had lead to the Ptolemaic doctrine. Now these ADs have been overcame. In the paper one considers four modern and not yet got over ADs, whose corollaries are false space-time geometry in the microcosm and most of problems and difficulties of the quantum field theory (QFT). One shows that ADs have a series of interesting properties: (1) ADs appear to be long-living delusions, because they are compensated partly by means of introduction of compensating (Ptolemaic) conceptions, (2) ADs influence on scientific investigations, generating a special pragmatic style (P-style) of investigations resembling the experimental trial and error method, (3) ADs act on investigations directly and via P-style, ADs direct the science development into a blind alley. One considers concrete properties of modern ADs and the methods of their over coming. From viewpoint of application the paper is an analysis of mistakes, made in the quantum theory development. One analyses reasons of these mistakes and suggests methods of their correction.

Keywords: logical reloading, associative mistakes, structural approach, foundation of quantum theory, multivariant geometry, physics geomerization, investigation styles.

I. Introduction

The logical reloading is a new logical operation [1]. It used in the classical particle dynamics and in the proper Euclidean geometry. In the classical particle dynamics the logical reloading changes the basic object of dynamics. A single deterministic particles S_{d} is replaced by a statistical ensemble $\mathcal{E}[S_{\mathrm{d}}]$ of particles S_{d}. As a result mathematical formalism of particle dynamics changes. Dynamics of discrete dynamic systems transforms to dynamics of continuous medium. As a result of the logical reloading the new formalism of the deterministic particle dynamics enables to describe dynamics of stochastic particles S_{st}, because the statistical ensemble $\mathcal{E}[S_{\mathrm{st}}]$ is a dynamic system, even if the statistical ensemble consists of stochastic particles S_{st}. Motion of a stochastic particle S_{st} cannot be described exactly. One can describe only mean motion of the stochastic particle. For instance, motion of a gas volume describes a mean motion of the gas molecules, whose exact motion is stochastic.

A change of the particle dynamics formalism is a very rare phenomenon. Last time it was changed in the beginning of the twentieth century, when the classical dynamics has been replaced by the quantum mechanics (the ordinary dynamics variables were replaced by matrix dynamic variables). The logical reloading conserves the classical dynamics in the sense that it does not introduce new fundamental conceptions such as wave function. However, it transfroms the dynamics of discrete dynamic systems to a classical dynamics of continuous medium and explains the wave function as a derivative concept. As a result the quantum mechanics appears to be founded as a classical dynamics of stochastic particles (of a continuous medium).

Contemporary researchers do not work with transformation of dynamics conceptions and transformation of the dynamics formalism. They work only with different Lagrangians in the framework of the same formalism (classical or quantum conception). Correctness of a Lagrangian choice can be tested by experiment. One solves dynamic equations generated by a chosen Lagrangian. The obtained calculated results can be tested experimentally. If the calculated results are true, one concludes, that the Lagrangian is taken correctly.

Correctness of a change of mathematical formalism of dynamics cannot be tested by one experimental test. The experimental test is to be made for all Lagrangians. If the result, calculated for a concrete Lagrangian, does not coincide with experiment, one cannot decide what is a reason of discrepancy: a choice of the new mathematical formalism or a choice of the Lagrangian. Working with the new mathematical formalism, one is forced to use another criterion of correctness, than coincidence with experiment. One is forced to look for defects, or

Author: Institute for Problems in Mechanics, Russian Academy of Sciences, 101-1, Vernadskii Ave., Moscow, 117526, Russia.
e-mail: rylov@ipmnet.ru

mistakes in the existing mathematical formalism of dynamics and to correct this mistake. Such an approach facilitates a choice of a new conception of dynamics (new mathematical formalism).

Thus, the investigation strategy in construction of a new conception of the particle dynamics (new mathematical formalism of dynamic) looks as follows. One looks for defects (mistakes) in the existing conception of dynamics and corrects the discovered mistakes. A search of mistakes in the existing dynamic conception is a very difficult problem. Most researchers believe that there are no mistakes in the existing conception of dynamics. Nevertheless a mistake has been found. It consists in the fact that the dynamic equations for relativistic particles are relativistic, but the particle state is nonrelativistic [2, 3]. Correction of this mistake led to the logical reloading in classical dynamics of stochastic particles. Mistake in the definition of the relativistic particle state is of no importance in the dynamics of deterministic relativistic particles, but it is important in the dynamics of stochastic relativistic particles, because one uses a statistical ensemble in this definition. The statistical ensemble is essentially a calculation of the particle states. In this case a true definition of the particle state is important.

A difficulty in perception of the quantum mechanics foundation is connected also with the fact, that the transformation from dynamical equations for the statistical ensemble to the Schrödinger (or Klein-Cordon) equation contains a partial integration, which leads to appearance of three arbitrary functions $g^{\alpha}(\boldsymbol{\xi}), \alpha = 1,2,3$. In the Schrödinger equation the wave function is constructed of these functions $g^{\alpha}(\boldsymbol{\xi})$. A transition from dynamic equations for the continuous medium to the Schrödinger equation is impossible without this integration.

Logical reloading in the Euclidean geometry leads to a monistic conception of a geometry, which is described completely in terms of a unique quantity: metric (world function). The logical reloading is also connected with some correction of geometric representations. In particular, after the logical reloading one refuses from the triangle axiom, which appears to be a special property of the proper Euclidean geometry. The logical reloading in the Euclidean geometry leads to a change of the mathematical formalism of the geometry. The obtained mathematical formalism is more general. It can be used in the case, when the triangle axiom does not take place.

Mistakes eliminated by the logical reloading are associative mistakes (associative delusions), which appear, when properties of one object are ascribed to another object. In the conventional formalism of a geometry the property of one-dimensionality of straight line segment (the triangle axiom), which is a property of the proper Euclidean geometry, is ascribed to any geometry at all. This constraint removes from consideration many space-time geometries, in particular, discrete geometries.

In practice the logical reloading in geometry and in classical dynamics were obtained as a result of discovery of associative delusions. I believe that this investigation strategy is most effective in the case, when the theoretical physics is in the blind alley. In this case a search of effective Lagrangians, basing on experimental data, is not effective, because in this case one works in the framework of existing conception. Changing a Lagrangian one obtain a description of a single physical phenomenon, whereas one needs to explain a wide class of physical phenomena. One needs to change a conception (existing mathematical formalism). This change can be carried out only by a change of conception. To change the existing conception one needs to search of associative delusions in the existing conception and to use the logical reloading. It is a very difficult problem, and one needs to know properties of the associative delusions.

The present paper is devoted to a study of associative delusions, their role in the natural science development and to problems of their overcoming.

II. The Associative Delusion. What is it?

The associative delusion means such a situation, when associative properties of human thinking actuate incorrectly, and the natural phenomenon is attributed by properties alien to it. Usually one physical phenomenon is attributed by properties of other physical phenomenon, or properties of the physical phenomenon description are attributed to the physical phenomenon in itself. Let us illustrate this in a simple example, which is perceived now as a grotesque.

It is known that ancient Egyptians believed that all rivers flow towards the North. This delusion seems now to be nonsense. But many years ago it had weighty foundation. The ancient Egyptians lived on a vast flat plane and knew only one river the Nile, which flowed exactly towards the North and had no tributaries on the Egyptian territory. The North direction was a preferred direction for ancient Egyptians who observed motion of heavenly bodies regularly. It was direction toward the fixed North star. They did not connect direction of the river flow with the plane slope, as we do now. They connected the direction of the river flow with the preferred spatial direction towards the North. We are interested now what kind of mistake was made by ancient Egyptians, believing that all rivers flow towards the North, and how could they to overcome their delusion.

Their delusion was not a logical mistake, because the logic has no relation to this mistake. The delusion was connected with associative property of human thinking, when the property P is attributed to the

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object O on the basis that in all known cases the property P accompanies the object O. Such an association may be correct or not. If it is erroneous, as in the given case, it is very difficult to discover the mistake logically. But it can be discovered experimentally.

However, if an associative delusion (AD) relates to a notion, an experimental test of the statement is impossible. In this case a discovery of the associative delusion is very difficult. For instance, the statement: (St_1) *A straight line is a one-dimensional set in any geometry* may be an associative delusion (AD), because we know only the Euclidean geometry and the Riemannian geometry, where the straight line (or geodesic) is a one-dimensional set. The statement St_1 is connected with the other statement: (St_2) *Any geometry is a logical construction, or any geometry is axiomatizable*. The last statement St_2 can be formulated in the form: (St_3) *Nonaxiomatizable geometries do not exist*.

The mathematical community believes, that there exist no nonaxiomatizable geometries, because one is not able to construct nonaxiomatizable geometries. Geometry has been arisen many years ago as a science on a shape of geometrical objects and on their mutual disposition in space. It was the proper Euclidean geometry $\mathcal{G}_{\mathrm{E}}$. Any geometrical object in $\mathcal{G}_{\mathrm{E}}$ can be constructed of blocks. Blocks are segments of straight line. Any geometrical object $\mathcal{O}$ can be filled by a set S of straight line segments L in such a way, that any point $\forall P\in \mathcal{O}$ belongs to one and only one segment $L\in \mathcal{S}$. Segments L have no common points. This property of $\mathcal{G}_{\mathrm{E}}$ can be used for construction of any geometrical object $\mathcal{O}$ of the Euclidean geometry $\mathcal{G}_{\mathrm{E}}$. Properties of the straight line segment can be formulated as some statements S_1. The rules of displacement of the straight line segments can be also formulated as some statements S_2. Using these statements S_1 and S_2, one can formulate the rules for construction of any geometrical object in $\mathcal{G}_{\mathrm{E}}$. Considering $St=S_1\wedge S_2$ as basic statements (axioms) of $\mathcal{G}_{\mathrm{E}}$, one can obtain the rules of any geometrical object construction as a logical corollary of St and of definition of the geometric object. These rules can be formulated as some statements. The set of these statements forms the proper Euclidean geometry $\mathcal{G}_{\mathrm{E}}$.

Such a form of the Euclidean geometry $\mathcal{G}_{\mathrm{E}}$ presentation can be qualified as the axiomatic conception of $\mathcal{G}_{\mathrm{E}}$. Connection of the logic with the Euclidean geometry was clear for contemporaries of Euclid. But now this connection is lost. One considers the logical construction of the proper Euclidean geometry as an evident thing.

The Euclidean geometry $\mathcal{G}_{\mathrm{E}}$ is considered formally as a logical construction founded on the set St of Euclidean axioms. Usually one does not consider the reasons, why the logic is connected with a geometry and why the Euclidean geometry $\mathcal{G}_{\mathrm{E}}$ is a logical construction. One believes, that any logical construction, containing axioms about properties of the simplest geometrical objects such as the straight line, describes some geometry $\mathcal{G}$, which may differ from $\mathcal{G}_{\mathrm{E}}$. The symplectic geometry has no relation to properties of geometrical objects. Nevertheless, it is treated as some kind of a geometry, because it is a logical construction, which is close to the Euclidean geometry $\mathcal{G}_{\mathrm{E}}$.

However, geometrical objects may be constructed as a result of a deformation of the Euclidean geometry $\mathcal{G}_{\mathrm{E}}$ into a generalized geometry $\mathcal{G}$. In this case a one-dimensional straight line segment $L_{\mathrm{E}}\subset \mathcal{G}_{\mathrm{E}}$ may be deformed into a hollow tube $L\subset \mathcal{G}$, which cannot be used as a constructing block. In this case the generalized geometry $\mathcal{G}$ obtained from $\mathcal{G}_{\mathrm{E}}$ as a result of a deformation will not be an axiomatizable geometry. Thus, the statements St_2 and St_3 appear to be associative delusions, if the space-time geometry (for instance, a discrete space-time geometry) is constructed by means of the deformation principle [4, 5, 1].

If the established association between the object and its property is erroneous, one can speak on associative delusion or on associative prejudice. The usual method of the associative delusions overcoming is a consideration of a wider set of phenomena, where the established association between the property P and the object O may appear to be violated, and the associative delusion may be discovered.

In this paper the associative delusions in natural sciences, mainly in physics are discussed. The associative delusions (AD) are very stable. They are overcame very difficultly, because they cannot be disproved logically. But there is an additional complication. The usual mistake is overcame easily by the scientific community, as soon as it has been overcame by one of its members. The corresponding article is published, and the scientific community takes it into account, and the mistake is considered to be corrected.

A different situation arises with the associative delusions (AD). Discovery of the associative delusion (AD), and publication of corresponding article do not lead to acknowledgment of AD as a delusion or mistake. The scientific community continue to insist on the statement, that the considered in the article AD is not a mistake in reality, and that the author of this paper makes himself a mistake. A long controversy arises. Sometimes it leads to a confiict, as in the case of conflict between the Ptolemaic doctrine and that of Copernicus. Finally, the truth celebrates victory, but the way to this victory appears to be long and difficult.

Apparently, the reason of the AD stability lies in obviousness and habitualness of those statements, which appear to be associative delusions afterwards. On the ground of these statements one constructs scientific conceptions, which agree with experimental

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data and observations. Declaring these habitual statements to be a delusions, one destroys existing scientific conceptions and tries to construct new conceptions. It is very difficult always for the scientific community.

In the science history a series of associative delusions is known. Let us list them in the chronological order.

AD.1. The antipodes paradox, generated by that the gravitational field direction is connected with a preferred direction in the space, but not with the direction towards the Earth center.

AD.2. The Ptolemaic doctrine in the celestial mechanics, where the property of being the "universe" center was attributed to the Earth, whereas the Sun is such a center.

AD.3. Prejudices against the Riemannian geometry in the second half of the XIX century are connected with that the Cartesian coordinate system was considered to be an attribute of any geometry, whereas it was only a method of the Euclidean geometry description.

AD.4. Impossibility of employment of the pure metrical conception of geometry, connected with the associative delusion, that the concept of the one-dimensional curve is considered to be a fundamental concept of any geometry, whereas the one dimensional curve is only a geometrical object, used in the Euclidean and the Riemannian geometry.

AD.5. The stochastic particles dynamics, when the basic object of dynamics is a single stochastic particle. Any statistical description is produced in terms of the probability theory, and the probability concept is considered as a fundamental concept of any statistical description.

AD.6. Identification of individual particle $\mathcal{S}$ with the statistically averaged particle $\langle\mathcal{S}\rangle$, used at the conventional interpretation of quantum mechanics. Such an identification is a kind of associative delusion, when the individual particle $\mathcal{S}$ properties are attributed to the statistically averaged particle $\langle\mathcal{S}\rangle$ and vice versa. The Schrödinger cat paradox and some other quantum mechanics paradoxes, connected with the wave function reduction, are corollaries of this identification.

AD.7. The forced identification of energy and Hamiltonian, used in relativistic quantum field theory (QFT), is also an associative delusion. As any associative delusion this identification is connected with attributing properties of one object to another one. Coincidence of energy and Hamiltonian for a free nonrelativistic particle is considered to be a fundamental property of any particle, whereas this property takes place only in the case, when there is no pair production.

The first three of the seven listed delusions (AD.1 .AD.3) had been overcame to the beginning of XX century, though a detailed analysis of these overcoming is, maybe, absent in the literature. As to AD.4 .AD.7, the scientific community is yet destined to overcome them. Besides, these ADs exist simultaneously, and the order of their listing corresponds basically to their importance rather, than to chronology.

The purely metric conception of geometry (CG), where all information on geometry is given by means of a distance between two space points, is the most general conception of geometry (CG). It generates the most complete list of geometries, suitable for the space-time description. AD.4 discriminates the purely metric CG. As a result instead of it one uses Riemannian CG, generating incomplete list of possible geometries. The true space-time geometry is absent in this list, and we are doomed to use the Minkowski geometry for the space-time description. The Minkowski geometry is incorrect geometry for small space-time scales, i.e. in the microcosm. In the true space-time geometry the microparticle motion is primordially stochastic, and the properties of the geometry are an origin of this stochasticity. In the Minkowski geometry the motion of any particle, described by the timelike world line, is deterministic, and incorrectness of the Minkowski geometry lies in this fact.

AD.5 leads to impossibility of a construction of a consecutive statistical description of the stochastically moving microparticles (electrons, positrons, etc.), although it is doubtless that quantum mechanics, describing the regular component of this motion, is a statistical theory. AD.4 and AD.5 establish such a situation, when one is forced to use a series of additional hypotheses (quantum mechanics principles) for a correct description of observed quantum phenomena. It reminds situation, when Ptolemeus used a series of additional constructions (epicycles, differents) for explanation of observed motion of heavenly bodies. They were needed for compensation of AD.2.

Overcoming of AD.5 admits one to eliminate the quantum mechanics principles and to construct the quantum phenomena theory as a consecutive classical dynamics of stochastic particle. At such a description the microparticle stochasticity has a geometric origin, i.e. it is generated by the space-time geometry. The consecutive classical description of the stochastic particles appears as a result of a change of the basic object of dynamics (*a single particle is replaced by a statistical ensemble*). The statistical ensemble is *a dynamic system* even in the case, when it consists of stochastic particles.

Overcoming of AD.5 and AD.4 admits one to use structural approach in the theory of elementary particles [1, 6], when one investigates the arrangement of elementary particles. The structural approach differs from the conventional empirical approach, which cannot investigate the arrangement of elementary particles. It can only ascribe some quantum numbers to any elementary particle. The difference between the structural approach and the empirical approach can be seen in the example of the chemical elements investigations. The structural approach (atomic physics) investigates the atom arrangement (nucleus, electron envelope), whereas the empirical approach (chemistry) ascribes some properties (atomic weight, valency, etc.) to any chemical element without penetration into atom arrangement. The mathematical formalism appears to be more developed in the case of the structural approach.

AD.6 has not such a global character as AD.4 and AD.5. It concerns mainly the interpretation of the concept of a measurement in quantum mechanics.

AD.7 has not the global character also. It acts only in the framework of the relativistic quantum field theory (QFT). QFT in itself reminds the Ptolemaic conception, i.e. a conception, which uses additional hypotheses (quantum mechanics principles), compensating incorrect choice of the space-time model. AD.7 (identification of energy and Hamiltonian $E = H$) generates a series of diffculties in QFT (non-stationary vacuum, necessity of the perturbation theory and some other). In fact, there is no necessity of the energy-Hamiltonian identification $E = H$. The secondary quantization can be carried out without imposing this constraint [7, 8]. The condition $E = H$ appears to be inconsistent with dynamic equations. Imposition of this constraint makes QFT to be inconsistent. On one hand, such an inconsistency leads to above mentioned difficulties, but on the other hand, such an inconsistency admits one to explain the pair production effect, because any inconsistent theory admits one to explain all what one wants. One needs only to show sufficient ingenuity. On one hand, elimination of the constraint $E = H$ leads to a theory which is consequent in the framework of quantum theory and free from the above mentioned difficulties, but on the other hand, it leads to that the theory ceases to describe the pair production effect. This deplorable fact means only, that the undertaken attempt of the FTP construction on the basis of unification of the relativity principles with those of quantum mechanics failed, and one should search for alternative conception.

Let us take into account that the quantum mechanics is a compensating (Ptolemaic) conception, i.e. just as the quantum mechanics principles have been invented for compensation of AD.4 and of AD.5 in the same way, as the Ptolemaic epicycles have been invented for compensation of AD.2. Then an attempt of unification of quantum mechanics principles with the relativity principles is as useless, as an attempt of introduction of Ptolemaic epicycles in Newtonian mechanics.

Apparently, the conception, appeared after overcoming of AD.4 and AD.5, is a reasonable alternative to QFT. Such a conception is consistently relativistic and quantum (in the sense that it contains the quantum constant $\hbar$, contained explicitly in the space-time metric). It does not contain the quantum mechanics principles, and one does not need to unite them with the relativity principles. We shall refer to this conception as the model conception of quantum phenomena, distinguishing it from conventional quantum mechanics, which will be referred to as axiomatic conception of quantum phenomena. The difference between the axiomatic conception and the model conception is much as the difference between the thermodynamics and the statistical physics. The thermodynamics may be qualified as the axiomatic conception of thermal phenomena, whereas the statistical physics may be qualified as the model conception of thermal phenomena. The transition from the axiomatic conception to the model one was carried out after a construction of the "calorific fluid" model (chaotic motion of molecules), and the thermodynamics axioms, describing properties of the fundamental thermodynamical object – "calorific fluid". Concept of "calorific fluid" is not used usually in the statistical physics, but if it is introduced, its properties are determined from its model (chaotic molecular motion).

Similar situation takes place in the interrelations between the axiomatic and model conceptions of quantum phenomena. In the axiomatic conception there is a fundamental object, called the wave function. Its properties are determined by the quantum mechanics principles. The wave function is that object, which distinguishes the quantum mechanics from the classical one, where the wave function is absent. In the model conception one constructs a "model of the wave function" [9]. Thereafter the wave function properties are obtained from this model, and one does not need the quantum mechanics principles. Axiomatic and model conceptions lead to the same result in the nonrelativistic case, but in the relativistic case the results are different, in general. For instance, application of the model conception to investigation of the dynamic system $\mathcal{S}_{\mathrm{D}}$, described by the Dirac equation, leads to another result [10, 11, 12], than investigation, produced by conventional methods in the framework of the axiomatic conception. In the first case the classical analog of the Dirac particle $\mathcal{S}_{\mathrm{D}}$ is a relativistic rotator, consisting of two charged particles, rotating around their common center of mass. In the second case the classical analog is a pointlike particle, having spin and magnetic moment. An existence of the associative delusion does not permit one to construct a rigorous scientific conception. The constructed building appears to be a compensating (Ptolemaic) conception, where an incorrect statement is compensated by means of additional suppositions. In general, the Ptolemaic conception is not true. But there are such fields of its application, where its employment leads to correct results, which agree with observations and experimental data. For instance, in the framework of the Ptolemaic doctrine one can choose such epicycles and differents for any planet, that one can calculate its motion in a sufficient long time so, that predictions agree with observations. But there is a class of the celestial mechanics problems, which could not be solved in the framework of the Ptolemaic doctrine. For instance, in the framework of this doctrine one cannot solve such a problem: when and with what velocity should one throw a stone from the Earth's surface, in order that it could drop on the Moon. In the framework of the Ptolemaic doctrine one cannot discover the gravitation law and construct the Newtonian mechanics. The associative delusion, embedded in the ground of the Ptolemaic doctrine and disguised by means of compensating hypotheses, hindered the progress of celestial mechanics. As far as in that time the celestial mechanics was the only exact natural science, AD hindered the normal development of natural sciences at all. The development of natural sciences went to blind alley. After overcoming of AD.2 the natural sciences development was accelerated strongly.

The same situation takes place with the quantum mechanics. Although at the first acquaintance the quantum mechanics seems to be a disordered collection of rules for calculation of mathematical expectations, nevertheless, in the nonrelativistic case an employment of these rules leads to results which agree with experiments. Accepting the quantum mechanical principles, the nonrelativistic quantum mechanics as a whole is a consistent conception, which describes excellently a wide class of physical phenomena. But at the transition to the field of relativistic phenomena (pair production, elementary particles theory) the quantum principles ceases to be sufficient. One is forced to introduce new suppositions. The further the quantum theory advances in the field of relativistic phenomena, the more new suppositions are to be introduced for descriptions of observed phenomena. This is an indirect indication, that the conventional way of the quantum theory development comes to a blind alley.

Investigation of possible methods of the associative delusions overcoming is a subject of this paper. On one hand, overcoming of any special associative delusion needs a knowledge of the subject of investigation and a professional approach to the investigation of the phenomenon. On the other hand, the Ptolemaic conceptions have some common properties, and a work with them has some specific character, which should be known, if we want to overcome corresponding ADs effectively.

First, it is very difficult to discover the associative delusion. Indirect indications of AD are an increasing complexity of the theory and a necessity of new additional suppositions. These indications show that the associative delusion does exist, but they do not permit one to determine, what is this AD.

Second, the work with Ptolemaic conceptions, i.e. with conceptions, containing AD, generates a special pragmatic style (P-style) of investigations. The P-style lies in the fact that one searches all possible ways of explanation and calculation of the considered phenomenon. Of course, different versions, considered at such an approach, are restricted by the existing mathematical technique and by the possibilities of the researcher's imagination. But these restrictions are essentially slighter, than the restrictions imposed by the classical style (C-style) of investigations. The classical style (C-style) is the style of investigations, which is fully developed in the natural sciences to the end of the XIX century.

Our classification of the investigation styles is rather close to the classification of Lee Smolin [13], who classify types of theories: (1) principal theory and (2) constructive theory. By definition, the principal theory is to be universal: it must be applicable to all phenomena, because it installs the main language, which is used for the nature description. Existence of two different principal theories is impossible.

The constructive theories describe some single phenomena in terms of specific models or equations. The constructive theories are associated with the P-style describing compensating conceptions, whereas the principal theories are associated with the C-style describing conceptions, where the associative delusions are not essential.

Unprejudiced reader will agree that the delusions AD.1-AD.3, having been overcame, are delusions indeed, and that it was worth to overcame them. But it is rather doubtless that he agrees at once that AD.4-AD.7 are also delusions and that they are to be overcame. If it were so, then AD.4-AD.7 have been overcame many years ago. Of course, ADs are undesirable as any other delusions. One should eliminate them, if it is possible. But one should not consider them as misunderstandings, or manifestations of researcher's stupidity. ADs are inevitable attributes of the cognitive processes. ADs were in the past, they exist now, and apparently, they will exist in the future. We should know, how to live with them and to make investigation. The situation resembles the situation with a noise. We transmit information at presence of a noise, and we know that the noise is undesirable, that the noise should be removed, and that, unfortunately, it cannot be removed completely.

One should study associative delusions, their properties and the influence on the style of thinking and on investigations of researchers, which are forced to work under conditions of the associative delusions presence. Investigation of ADs properties and possibilities of their overcoming is a goal of this paper. We begin with detailed investigations of AD.4 .AD.7, to make sure that they are delusions indeed and to understand how to overcome them. It is very important, because experience of overcoming of AD.2 (Ptolemaic doctrine) shows that the overcoming process is very difficult for scientific community.

Usually one connects these difficulties with a negative role of the Catholic church. B.V. Raushenbach [14] considers that the position of the Catholic church is not the case. It was incompetent in problems of celestial mechanics. It agreed simply with opinion of the most of that time researchers. Most of scientists of that time were priests, and B.V. Raushenbach considers that they used the Catholic church simply as a tool for a fight against proponents of the Copernicus doctrine. Experience of the author in attempts of overcoming of AD.4 - AD.7 shows, that this is B.V. Raushenbach, who is right.

In sections 2 .5 one considers properties of AD.4-AD.7. In the seventh section influence of associative delusions on the style of investigations is considered.

III. Conception of Geometry and a Correct Choice of the Space-Time Geometry

The conception of geometry (CG) is considered to be the method (a set of rules), by means of which the geometry is constructed. The proper Euclidean[1] geometry can be constructed on the basis of different geometric conceptions.

For instance, one can use the Euclidean axiomatic conception (Euclidean axioms), or the Riemannian conception of geometry (dimension, manifold, metric tensor, curve). One can use the topology-metric conception of geometry (topological space, metric, curve). In any case one obtains the same proper Euclidean geometry. From point of view of this geometry it is of no importance which of possible geometric conceptions is used for the geometry construction.

But if we are going to choose a geometry for the real space-time, it is very important, that the list of all possible geometries, suitable for the space-time description, would be complete. If the true space-time geometry is absent in this list, we are doomed to a choice of a false geometry independently of the method which is used for a choice of the space-time geometry. Thus, a determination of the complete list of all possible geometries is a necessary condition of a correct choice of the real space-time geometry. In turn the determination of the possible geometries list depends on the conception of geometry (CG), which is used for determination of the list of possible geometries. Any of possible CG contains information of two sorts:

(1) non-numerical information in the form of concepts, axioms and propositions, formulated verbally, (2) numerical information in the form of numbers and numerical functions of space points. In different CG this information is presented differently.

title of CG	*non-numerical information*	*numerical information*
Euclidean CG	Euclidean axioms	$\emptyset$
Riemannian CG	Manifold, curve coordinate system	$n, \quad g_{ik}(x)$
topology-metric CG	topological space, curve	$\rho(P,Q) \geq 0,$ $\rho(P,Q) = 0, \quad \text{iff} \quad P = Q$ $\rho(P,Q) + \rho(Q,R) \geq \rho(P,R)$
purely metric CG	$\emptyset$	$\sigma(P,Q) = \frac{1}{2}\rho^2(P,Q) \in \mathbb{R}$

Varying continuously numbers and functions, constituting numerical information of CG, one obtains a continuous set of geometries in the framework of one CG. Each of them differs slightly from the narrow one. Any admissible value of numerical information is attributed to some geometry in the framework of the given CG. One can also change non-numerical information, replacing one axiom by another. But at such a replacement the geometry changes step-wise, and one should monitor that replacements of one axiom by another do not lead to inconsistencies. It is complicated and inconvenient. It is easier to obtain new geometries in the framework of the same conception, changing only numerical information.

One can see from this table, that different CG have different capacity of the numerical information and generate the geometry classes of different power. The Euclidean CG does not contain the numerical information at all. Vice versa, the purely metric CG contains only numerical information and generates the most powerful class of geometries which will be referred to as physical geometries.

[1] We use the term "Euclidean geometry" as a collective concept with respect to terms "proper Euclidean geometry" and "pseudo-Euclidean geometry". In the first case the eigenvalues of the metric tensor matrix have similar signs, in the second case they have different signs.

The physical geometry has many attractive features. Firstly, it is very simple and realizes the simple attractive idea, that for determination of a geometry on a set of points P it is sufficient to give the distance $\rho(P,Q)$ between all pairs $\{P,Q\}$ of points of the set Ω. In fact, the distance $\rho(P,Q)$ is determined by means of the world function $\sigma=\frac{1}{2}\rho^2$ on the set $\Omega\times\Omega$. In spite of simplicity and attraction of this idea the existence possibility of the purely metric CG was being problematic for a long time. K. Menger [15] and J.L. Blumenthal [16] tried to construct so called distance geometry, which was founded on the concept of distance in a larger degree, than it is made in the topology-metric CG. But they failed to construct the purely metric CG. The reason of the failure was AD.4. The formulation of necessary and sufficient conditions of the geometry Euclideness in terms of the world function σ, given on the set $\Omega\times\Omega$, was a crucial step in construction of the purely metric CG. The prove [17, 18, 19] of the fact, that the Euclidean geometry can be constructed in terms of only σ meant a possibility of construction of any physical geometry in terms of σ. It meant existence of the purely metric conception of geometry (CG), which is a monistic conception.

In the framework of purely metric CG all information on geometry is derived from the world function. In particular, if one can introduce a dimension of the space $\{\Omega,\sigma\}$, this information can be derived from the world function [19]. From the world function one can derive information on continuity, or discontinuity of the space $\{\Omega,\sigma\}$. In the case of continuous geometry the information on the coordinate systems and on metric tensor can be also derived from the world function. In physical geometry there is an absolute parallelism (which is absent in Riemannian geometries). Besides the physical geometry has a new property-multivariance (nondegeneracy).

The geometry is multivariant (nondegenerate), if at the point P_0 there are many vectors $\mathbf{P}_0\mathbf{Q},\mathbf{P_0Q}',\mathbf{P_0Q}''$... which are equivalent to the vector $\mathbf{AB}$ at the point A, but vectors $\mathbf{P}_0\mathbf{Q},\mathbf{P_0Q}',\mathbf{P_0Q}''$,...are not equivalent between themselves. In the degenerate (single-variant) geometry there is only one such a vector $\mathbf{P}_0\mathbf{Q}$, $\forall P_0\in$.

Multivariance of physical geometry may be conceived as follows. Any physical geometry can be obtained from the Euclidean geometry by means of its deformation (i.e. a change of distance $\rho(P,Q)$ between the space points). At such a deformation the geometrical objects of Euclidean geometry change their shape. If the obtained physical geometry is degenerate, the Euclidean straights transform to lines, which are curved lines, in general. But it is possible such a deformation, that the straight of n-dimensional Euclidean space converts into (n-1)-dimensional tube. For it would be a possible, the straight is to be defined as a set of points, possessing some property of the Euclidean straight. Definition of the straight as a curve, possessing some property of the Euclidean straight prohibits automatically deformation of the Euclidean straight into (n-1)-dimensional tube and discriminates nondegenerate geometries.

It is easy to see that a segment $\mathcal{T}_{[P_0P_1]}$ of the straight line in the Euclidean geometry $\mathcal{G}_{\mathrm{E}}$ is described as follows

$$\mathcal{T}_{[P_0P_1]}=\{R|\rho(P_0,R)+\rho(R,P_1)-\rho(P_0,P_1)=0\},\quad \rho(P_0,P_1)=\sqrt{2\sigma(P_0,P_1)} \tag{3.1}$$

where $\rho(P_0,P_1)$ is the distance in $\mathcal{G}_{\mathrm{E}}$ between the points P_0 and P_1.

If one considers nondegenerate physical geometry of the space-time, the motion of free particles in such a space-time appears to be stochastic, although the geometry in itself (i.e. the world function σ) is deterministic. In other words, multivariance (nondegeneracy) of the space-time geometry generates an indeterminism.

In the Riemannian CG the deformation, converting a line into a tube, is forbidden. It is connected with AD.4, according to which the curve is a fundamental object of geometry, and there do not exist such geometries, where the curve would be replaced by a surface. It is in this point, where AD.4 discriminates purely metric CG and physical geometries, generated by this CG. As a corollary the list of possible geometries reduces strongly. The true space-time geometry fall out of the list of possible geometries, and one chooses a false model for the space-time.

In the present time one uses the Riemannian conception for obtaining the space-time geometry. In the simplest case, when one can neglect gravitation, the space-time is uniform, isotropic and flat. In the framework of the Riemannian geometry there is only one flat uniform isotropic geometry. It is the Minkowski geometry, for which the world function has the form:

$$\sigma_{\mathrm{M}}(x,x')=\sigma_{\mathrm{M}}(t,\mathbf{x};t',\mathbf{x}')=\frac{1}{2}\left(c^2(t-t')^2-(\mathbf{x}-\mathbf{x}')^2\right) \tag{3.2}$$

where c is the speed of the light, and $x=\{t,\mathbf{x}\}$, $x'=\{t',\mathbf{x}'\}$ are coordinates of two arbitrary points in the space-time.

Thus, in the case of Riemannian CG the problem of choosing space-time geometry does not appear. It is determined uniquely.

The topology-metric CG cannot be applied to the space-time, because it supposes that $\sigma(P,Q) = \frac{1}{2}\rho^2(P,Q) \geq 0$, whereas in the space-time there are spacelike intervals, for which $\sigma(P,Q) < 0$.

The purely metric CG generates a whole class of uniform isotropic physical geometries, labelled by a function of one argument. In this case the world function has the form

$$\sigma(x,x') = \sigma_{\mathrm{M}}(x,x') + D(\sigma_{\mathrm{M}}(x,x')), \quad (3.3)$$

where σ_{M} is the world function for the Minkowski space (3.2), and the function *D* is an arbitrary function, labelling possible uniform isotropic geometries. These geometries differ one from another in the shape of tubes, obtained as a result of the Euclidean straight deformation. Hence, they differ in the stochasticity character of the free particles motion. For the purely metric CG the problem of choice of the space-time geometry is very important, because there are many uniform isotropic geometries. To set $D\equiv 0$ in (3.3) and to choose the Minkowski geometry would be incorrect, because in the Minkowski geometry the motion of particles is deterministic. But it is well known that the motion of real microparticles (electrons, positrons, etc.) is stochastic. In other words, experiments with single particles are irreproducible. Only distributions of results, i.e. results of mass experiments with many similarly prepared particles are reproducible. These distributions of results are described by quantum mechanics, constructed on the basis of some additional hypotheses, known as principles of quantum mechanics.

When there are such space-time geometries, where the motion of particles is primordially stochastic, one cannot consider as reasonable such an approach, where at first one chooses the Minkowski geometry with deterministic motion of particles, and thereafter one introduces additional suppositions (quantum mechanics principles), providing a description of the stochastic motion of free particles. It would be more correct to choose the space-time geometry in such a way, that dynamics (statistical description) of stochastic motion of free particles would describe correctly experimental data. As far as the quantum mechanics describes all nonrelativistic experiments very well, it is sufficient to choose the space-time geometry so, that the statistical description of stochastic motion of free particles would agree with predictions of quantum mechanics.

At first sight, it seems that the quantum effects cannot be explained by peculiarities of geometry, because intensity of quantum effects depends on the particle mass essentially, and the mass is such a characteristic of a particle, which is not connected with a geometry. It seems that influence of a geometry on the particle motion is to be similar for particles of any mass. In reality the in.uence of geometry does not depend on particle mass only in the degenerate geometry (Minkowski geometry). In the space-time with the degenerate geometry the particle mass is not a geometrical characteristic.

The world tube of the particle with the mass *m* is described by the broken world tube $\mathcal{T}_{\mathrm{br}}$, which is determined by a sequence of the break points $\{P_i\}\, i = 0 \pm 1, \pm 2, \ldots$ The adjacent points P_i, P_{i+1} are connected between themselves by a segment $\mathcal{T}_{[P_iP_{i+1}]}$ of the straight. This segment is determined by the relation (3.1)

$$\mathcal{T}_{[P_iP_{i+1}]} = \{R|\rho(P_i,R) + \rho(R,P_{i+1}) = \rho(P_i,P_{i+1})\} \quad (3.4)$$

where $\rho(P_i,P_{i+1}) = \sqrt{2\sigma(P_i,P_{i+1})}$ is the distance between the P_i and P_{i+1}. The set of points $\{P_i\}$, $i = 0, \pm 1, \pm 2, \ldots$ will be referred to as the skeleton of the tube $\mathcal{T}_{\mathrm{br}}$.

In the proper Euclidean geometry as well as in the Minkowski geometry (for timelike interval $\rho^2(P_i,P_{i+1}) > 0$) the set of points (3.4) forms a segment of the straight line, connecting points P_i, P_{i+1}. In the nondegenerate geometry the set $\mathcal{T}_{[P_iP_{i+1}]}$ forms a three-dimensional cigar-shaped surface with the ends at the points P_i, P_{i+1}.

The vector $\mathbf{P}_i\mathbf{P}_{i+1} = \{P_i, P_{i+1}\}$ is interpreted as the particle 4-momentum on the segment $\mathcal{T}_{[P_iP_{i+1}]}$ of the particle world tube $\mathcal{T}_{\mathrm{br}}$

$$\mathcal{T}_{\mathrm{br}} = \bigcup_i \mathcal{T}_{[P_iP_{i+1}]}. \quad (3.5)$$

The length $|\mathbf{P}_i\mathbf{P}_{i+1}| = \rho(P_i,P_{i+1}) = \sqrt{2\sigma(P_i,P_{i+1})}$ of the vector $\mathbf{P}_i\mathbf{P}_{i+1}$ is the geometrical mass μ of the particle, expressed in units of length. The universal constant *b* connects the geometrical mass μ with the usual mass m of the particle.

$$m = b\mu = b\rho(P_i,P_{i+1}),\ i = 0, \pm 1, \pm 2, \ldots\ [b] = \mathrm{g/cm} \quad (3.6)$$

All segments $\mathcal{T}_{[P_iP_{i+1}]}$, $i = 0, \pm 1, \pm 2, \ldots$ has the same length $\mu = m/b$. Thus, in general, m is a geometrical characteristic of the particle, but in the case of the Minkowski geometry one cannot determine the particle mass, using the world line shape, because one cannot determine points P_i of the world line $\mathcal{T}_{\mathrm{br}}$ skeleton on the basis of the world line shape. In the case of multivariant (nondegenerate) space-time geometry the points P_i of the skeleton are end points of the cigar-shaped segments $\mathcal{T}_{[P_iP_{i+1}]}$. They can be determined via presentation of the broken tube (3.5). Interval $\rho(P_i,P_{i+1})$ between adjacent points P_i of the world line skeleton determines the geometrical mass μ of the particle.

For a free particle the 4-momenta $\mathbf{P}_i\mathbf{P}_{i+1}$ and $\mathbf{P}_{i+1}\mathbf{P}_{i+2}$ of two adjacent segments $\mathcal{T}_{[P_iP_{i+1}]}$ and $\mathcal{T}_{[P_{i+1}P_{i+2}]}$ are parallel $\mathbf{P}_i\mathbf{P}_{i+1} \uparrow\uparrow \mathbf{P}_{i+1}\mathbf{P}_{i+2}$. In the Minkowski geometry there is only one vector $\mathbf{P}_{i+1}\mathbf{P}_{i+2}$ of the length μ, parallel to timelike vector $\mathbf{P}_i\mathbf{P}_{i+1}$. Hence, if the vector $\mathbf{P}_0\mathbf{P}_1$ is fixed, all other vectors $\mathbf{P}_i\mathbf{P}_{i+1}$ $i = 1, 2, ..$ are determined uniquely. In other words, in the Minkowski geometry the total world line $\mathcal{T}_{\rm br}$ is determined uniquely, provided one of its segments is fixed. It means that the motion of a free particle in the space-time with Minkowski geometry is deterministic.

In the space-time with multivariant geometry there are many vectors $\mathbf{P}_{i+1}\mathbf{P}_{i+2}$ of the length μ, parallel to the timelike vector $\mathbf{P}_i\mathbf{P}_{i+1}$. It means that the end P_{i+2} of the vector $\mathbf{P}_{i+1}\mathbf{P}_{i+2}$ is not determined uniquely, even if the vector $\mathbf{P}_i\mathbf{P}_{i+1}$ is fixed. Other points P_{i+3}, P_{i+4},... are not determined uniquely also. It means that the broken tube $\mathcal{T}_{\rm br}$ is stochastic. Thus, the motion of a free particle in the space-time with multivariant (nondegenerate) geometry is stochastic. The character and intensity of the stochasticity depends on the form of the function $D\left(\sigma_{\rm M}\right)$ in the relation (3.3).

Supposing that the statistical description of stochastic world tubes gives the same result, as the quantum-mechanical description in terms of the Schrödinger equation, one can calculate the distortion function $D\left(\sigma_{\rm M}\right)$. The calculation gives [20]

$$D = D\left(\sigma_{\rm M}\right) = \begin{cases} d & \text{if} \quad \sigma_{\rm M} > \sigma_0 \\ f\left(\sigma_{\rm M}\right) & \text{if} \quad \left|\sigma_{\rm M}\right| \leq \sigma_0 \\ -d & \text{if} \quad \sigma_{\rm M} \leq -\sigma_0 \end{cases} \qquad (3.7)$$

$$d = \frac{\hbar}{2bc} = \text{const} \approx 10^{-21}\text{cm}, \quad \sigma_0 = \text{const} \approx d$$

Here $\hbar$ is the quantum constant, and $b \approx 10^{-17}$ g/cm is a new universal constant. $f(\sigma_{\rm M})$ is an arbitrary function of the order σ_0.

From the three-dimensional viewpoint the particle is a pulsating sphere. Period T of pulsations depends on the particle mass m. It is determined by the relation $T = \mu/c = m/(bc)$, where b is the universal constant. The maximal sphere radius $R_{\max} \approx \sqrt{d}$ does not depend on the particle mass. One can assume approximately that in the period T the sphere radius increases from zero up to maximal value $R_{\max}$, and then it reduces to zero. In the period T the sphere center moves along the straight line uniformly. At the collapse moment a random jump-like change of velocity takes place. In the coordinate system, where the sphere is at rest the velocity jump is equal approximately to $R_{\max}/T \approx \sqrt{d}/T \approx m^{-1}\left(\hbar bc/2\right)^{1/2}$. The less is the particle mass the larger is the velocity jump. Besides, the period T depends on the particle mass. As a result for the particle of small mass the random velocity jumps happen more often and have the larger magnitude. Thus, choosing the space-time geometry in the form (3.3), (3.7), one can explain all nonrelativistic quantum properties effects without referring to quantum principles. Such a space-time geometry is more correct, than the Minkowski geometry, because in this case one does not need additional hypotheses in the form of quantum principles. In such a geometry the quantum constant appears in the theory together with the distortion function (3.7). It is an attribute of the space-time, that agrees with the universal character of the quantum constant $\hbar$.

IV. Dynamical Conception of Statistical Description

As we have mentioned, the choice of the space-time geometry is determined by the condition that the statistical description of the stochastic motion of particles is to coincide with the nonrelativistic quantum-mechanical description. It means that the quantum mechanics is to be represented as a statistical description of randomly moving particles. In the end of XIX century the thermodynamics was presented as a statistical description of chaotically moving molecules. After this representation many researchers thought that something like that can be made with the quantum mechanics. It is a common practice to think that any statistical description is produced in terms of the probability theory. In this point we meet AD.5, where it is supposed that there is no statistical description without the probability theory. Attempts [21, 22] of formulating the quantum mechanics in terms of the probability theory failed. The fact is that, attempting to represent the quantum mechanics as a statistical description of stochastic particle motion, one overlooks usually, that the random component of the particle motion can be relativistic, whereas the regular component remains to be nonrelativistic.

The probability theory, applied successfully to the statistical physics for statistical description of the chaotic molecule motion, is not suitable for a description of the stochastic motion of relativistic particles. The fact is that, the employment of the probability density supposes splitting of all possible system states into sets of simultaneous independent events. In the relativistic theory it cannot be made for a continuous dynamic system, as far as there is no absolute simultaneity in the special relativity. The simultaneity at some coordinate system cannot be used also, because the coordinate system is a method of description. Application of the probability theory and of the conditional simultaneity (simultaneity at some coordinate system) means an application of the statistics to the description methods instead of the necessary calculation of the dynamic system states.

One can overcome the appeared obstacle, rejecting employment of the probability theory at the statistical description. Indeed, the term "statistical description" means only that one considers many

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identical, or almost identical objects. Application of the probability theory in the statistical description is not necessary, because it imposes some constraints on the method of the description, that is undesirable. For instance, the probability density must be nonnegative, and sometimes this constraint cannot be satisfied.

In the nonrelativistic physics the physical object is a particle, i.e. a point in the usual space or in the phase one. The density of points (particles) in the space is nonnegative, it is a ground for introduction of the probability density concept. In the relativistic theory the physical object is a world line in the space-time. The density of world lines in the vicinity of some point x is a 4-vector, which cannot be a ground for introduction of the probability density.

$$dN = j^k dS_k \tag{4.1}$$

where dS_k is spacelike area at the point x, dN is the flux of world line through the area dS_k. the vector j^k describes the density of world lines in vicinity of the point x. The alternative version, when any world line is considered to be a point in some space $\mathcal{V}$ of world lines, admits one to introduce the concept of the probability density in the space $\mathcal{V}$ of world lines. But such a description is non-local, as far as two world lines, coinciding everywhere except for some remote regions, are represented by different points in $\mathcal{V}$, and this points are not close, in general. In other words, such an introduction of the probability is very inconvenient.

To get out of this situation, one needs to reject from employment of the probability theory at the statistical description. Instead of the probabilistic conception the dynamical conception of statistical description (DCSD) should be used. Instead of the stochastic system $\mathcal{S}_{\rm st}$, for which there are no dynamic equations, one should use a set $\mathcal{E}[N,\mathcal{S}_{\rm st}]$, consisting of large number N of identical independent systems $\mathcal{S}_{\rm st}$. It is known as the statistical ensemble of systems $\mathcal{S}_{\rm st}$. The statistical ensemble $\mathcal{E}[N,\mathcal{S}_{\rm st}]$ forms a deterministic dynamical system, for which there are dynamic equations, although they do not exist for elements $\mathcal{S}_{\rm st}$ of the statistical ensemble. The statistical description lies in the fact that one investigates properties of $\mathcal{E}[N,\mathcal{S}_{\rm st}]$ as a deterministic dynamic system, and on the basis of this investigation one makes some conclusions on properties of its elements (stochastic systems $\mathcal{S}_{\rm st}$)). As far as one investigates a dynamic system (statistical ensemble) and its properties, there is no necessity to use the concept of probability.

Concept of the statistical ensemble has been introduced by J. W. Gibbs [23]. According to his definition an ensemble (also statistical ensemble) is an idealization consisting of a large number of virtual copies (sometimes infinitely many) of a system, considered all at once, each of which represents a possible state that the real system might be in. In other words, a statistical ensemble is a probability distribution for the state of the system.

Along with the statistical ensemble $\mathcal{E}[N,\mathcal{S}]$ of systems S, or even instead of it, one can introduce the statistically averaged dynamic system $\langle\mathcal{S}\rangle$, which is defined formally as a statistical ensemble $\mathcal{E}[N,\mathcal{S}]$, $(N\rightarrow\infty)$, normalized to one system. Mathematically it means that, if $\mathcal{A}_{\rm E}[N,d_N\{X\}]$ is the action for $\mathcal{E}[N,\mathcal{S}]$, then

$$\langle\mathcal{S}\rangle: \quad \mathcal{A}_{\langle S\rangle}[d\{X\}] = \lim_{N\rightarrow\infty}\frac{1}{N}\mathcal{A}_{\rm E}[N,d_N\{X\}], \qquad d\{X\} = \lim_{N\rightarrow\infty} d_N\{X\}$$

is the action for $\langle\mathcal{S}\rangle$, where X is a state of a single system $\mathcal{S}$, and $d_N\{X\}$ is the distribution, describing in the limit $N\rightarrow\infty$ both the state of the statistical ensemble $\mathcal{E}[N,\mathcal{S}]$ and the state of the statistically averaged system $\langle\mathcal{S}\rangle$.

Replacement of the statistical ensemble $\mathcal{E}[N,\mathcal{S}]$ by the statistically averaged system $\langle\mathcal{S}\rangle$ is founded on the insensibility of the statistical ensemble to the number N of its elements, under condition that N is large enough. The statistically averaged system $\langle\mathcal{S}\rangle$ is a kind of a statistical ensemble. Formally it is displayed in the fact that the state of $\langle\mathcal{S}\rangle$, as well as the state of the statistical ensemble $\mathcal{E}[N,\mathcal{S}]$ is described by the distribution $d_N\{X\}$, $N\rightarrow\infty$, whereas the state of a single system $\mathcal{S}$ is described by the quantities X, but not by their distribution. Using this formal criterion, one can distinguish between the individual dynamic system $\mathcal{S}$ and the statistically averaged system $\langle\mathcal{S}\rangle$.

To obtain the quantum mechanics as a statistical description of stochastic motion of particles, one needs to make one important step more. It is necessary to introduce the wave function ψ, which is the main object of quantum mechanics. Usually the wave function is introduced axiomatically, i.e. as an object, satisfying a system of axioms (principles of quantum mechanics). For this reason the meaning of the wave function is obscure. To clarify it, one has to introduce the wave function as an attribute of some model.

If S is a particle (deterministic or random), then the statistical ensemble $\mathcal{E}[N,\mathcal{S}]$ of particles S, or statistically averaged particle $\langle\mathcal{S}\rangle$ are continuous dynamic systems of the fluid type. It is well known [24], that the Schrödinger equation can be rep-resented as an equation, describing irrotational flow of some ideal fluid. In other words, the wave function can be considered to be an attribute of irrotational fluid flow. One can show [9], that the reciprocal statement (any fluid flow can be de- scribed in terms of a wave function) is also valid. The rotational flow is described by a many-component wave function. In other words, at the rotational flow the spin appears.

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As far as the statistically averaged particle $\langle\mathcal{S}\rangle$ is a dynamical system of a fluid type, the wave function appears to be a description method of this fluid $\langle\mathcal{S}\rangle$. In order the statistical description of the particle S coincides with the quantum mechanical description, it is necessary to find the state equation of the fluid $\langle\mathcal{S}\rangle$, which is determined in turn by the form of the distortion function D. Corresponding calculation was made in the paper [20]. This calculation determines the form (3.7) of the distortion function. Then one obtains the conception, which will be referred to as the model conception of quantum phenomena (MCQP). For the conventional presentation of quantum mechanics the term "the axiomatic conception of quantum phenomena"(ACQP) will be used.

Dynamical conception of statistical description (DCSD) generates a less informative description, than the probabilistic statistical description in the sense that some conclusions and estimations, which can be made at the probabilistic description, cannot be made in the framework of DCSD. One is forced to accept this, because one cannot obtain a more informative description. The fact, that the quantum mechanics is perceived as a dynamical (but not as a statistical, i.e. probabilistic) conception, is connected with the employment of DCSD. In turn application of DCSD is conditioned by "relativistic roots"of the nonrelativistic quantum mechanics. The "dynamic perception" of quantum mechanics takes place in the framework of both conceptions MCQP and ACQP. Let us note that DCSD is an universal conception in the sense that it can by used in both relativistic and nonrelativistic cases.

V. Identification of Individual Particle with the Statistically Averaged One

"Dynamical perception" of quantum mechanics leads to the fact that the statistically averaged particle $\langle\mathcal{S}\rangle$, described by the wave function, is considered to be simply a real particle $\mathcal{S}$. The question, why the real particle $\mathcal{S}$ is described by the wave function ψ, i.e. by a continuous variable (but not by position and momentum as an usual particle), is answered usually, that it is conditioned by the quantum character of the particle. One refers usually to the quantum mechanics principles, according to which the quantum particle state is described by the wave function ψ, whereas the classical one is described by a position and a momentum. At this point we meet AD.6, when one does not differ between the statistically averaged particle $\langle\mathcal{S}\rangle$ and the individual particle S.

As a corollary of such an identification the properties of $\langle\mathcal{S}\rangle$ and $\mathcal{S}$ are confused, and an object with inconsistent properties appears [25]. As long as we work with mathematical technique of quantum mechanics, dealing only with $\langle\mathcal{S}\rangle$, no contradictions and no paradoxes appear. But as soon as the measurement process is described, where both objects $\langle\mathcal{S}\rangle$ and $\mathcal{S}$ appear, the ground for inconsistencies and paradoxes come into existence. Combinations of contradictory properties may be very exotic.

There are at least two different measurement processes. The measurement ($\mathcal{S}$-measurement), produced under an individual system S, leads usually to a definite result and does not influence the wave function, which is an attribute of the statistically averaged system $\langle\mathcal{S}\rangle$. The measurement (M-measurement), produced under the statistically averaged system $\langle\mathcal{S}\rangle$, is a set of many $\mathcal{S}$-measurements, produced under individual systems $\mathcal{S}$, constituting the statistically averaged system $\langle\mathcal{S}\rangle$. The $\mathcal{M}$-measurement changes the wave function of the system $\langle\mathcal{S}\rangle$ and does not lead to a definite result. It leads to a distribution of results.

The following situation takes place the most frequently. One considers that the wave function describes the state of an individual system, and a measurement, produced under individual system, changes the state (wave function) of this system. As a result a paradox, connected with the wave function reduction and known as the Schrödinger cat, appears. A corollary of such an approach is so called many-world interpretation of quantum mechanics [26, 27].

VI. Identification of Hamiltonian and Energy at the Secondary Quantization of Relativistic Field

The energy of a closed dynamic system is defined as the integral from the time component T^{00} of the energy-momentum tensor

$$E=\int T^{00}d\mathbf{x} \tag{6.1}$$

The energy is a very important conservative quantity. The Hamilton function (Hamiltonian) of the system is a quantity canonically conjugate to the time, i.e. the quantity, determining the time evolution of the system. By their definitions the Hamiltonian H and the energy E are quite different quantities. But in the non-relativistic physics (classical and quantum) these quantities coincide in many cases. For instance, the energy of a particle in a given potential field $U(\mathbf{x})$ has the form $E=\mathbf{p}^2/2m+U(\mathbf{x})$. The Hamiltonian of the particle has the same form. On the ground of this coincidence an illusion appears, that the energy E of a dynamical system plays a role of the quantity, determining its evolution, i.e. the role of its Hamiltonian H. An illusion appears that the energy and the Hamiltonian are synonyms, i.e. two different names of the same quantity. In reality, if the particle is described in terms of world lines, and the world line (not a particle) is the basic object of dynamics, the energy E and

Hamiltonian H are different quantities [28]. The identification of energy and Hamiltonian of a free particle is admissible, if there is no pair production.

The identification of energy and Hamiltonian is used in the relativistic quantum theory, where there is a pair production, and such an identification cannot be used. For instance, it is common practice to consider [29], that in the dynamic system $\mathcal{S}_{\mathrm{KG}}$, described by the Klein-Gordon equation, the particle energy may be both positive and negative. A ground for such an statement is the fact that the flat wave in $\mathcal{S}_{\mathrm{KG}}$ has the form

$$\psi = Ae^{\frac{i}{\hbar}(k_0 t-\mathbf{kx})},\quad c=1 \tag{6.2}$$

where the quantity $k_0=\sqrt{m^2+\mathbf{k}^2}$ is interpreted as an energy. The light speed $c=1$. k_0 may be both positive and negative. The statement that the energy may be negative is made in spite of the fact that the energy-momentum tensor component

$$T^{00}=m^2\psi^*\psi+\nabla\psi^*\nabla\psi \tag{6.3}$$

which enters in the expression (6.1), takes only nonnegative values. In reality, the quantity k_0 is a time component of the canonical momentum (or Hamiltonian), which can have any sign. But the particle energy is always nonnegative.

Thus, in the given case one has the associative delusion (AD.7), which lies in the fact that the properties of Hamiltonian are attributed to the energy. As long as such an identification is produced on the verbal level, it leads only to a confusion in interpretation and nothing more. But in the quantum field theory (QFT) such an identification has a mathematical form, and it has far-reaching consequences for the secondary quantization of the scalar field ψ. The additional constraint $E=H$ leads to the fact that the zigzaglike world line, describing the pair production, is divided into segments. Each of segments is timelike. Some of segments have $H=k_0=\sqrt{m^2+\mathbf{k}^2}>0$. They describe particles. Another segments have $H=k_0=\sqrt{m^2+\mathbf{k}^2}<0$. they describe antiparticles. The problem, which can be described by finite number of objects (world lines), is described in the contemporary theory by indefinite number of objects (particles and antiparticles). As a result such a problem can be described only by the perturbation theory methods. The vacuum state appears to be nonstationary for the case of the second quantization of nonlinear Klein-Gordon equation. Nonstationary vacuum state, describing empty space-time, is nonsense. In order to remove this absurd sitation, one considers that the vacuum state is filled by virtual particles. Hence, existence of mysterious virtual particles is a corollary of additional constraint $E=H$.

The second quantization without the constraint $E=H$ admits one to reduce the problem of pair production to a set of problems containing one world line, two world lines and so on [7]. These problems can be solved without a use of the perturbation theory. The condition $E=H$ is a associative delusion, when the relation, which is valid in the case, when the pair production is absent, is extended to the case, when the pair production does exist.

Overcoming of AD.7 was the first overcoming (1970) among all overcoming of AD.4 - AD.7. It was important, because it showed that there may be associative delusions in the contemporary theoretical physics. The most contemporary physicists believe that there are no mistakes in fundament of contemporary theoretical physics. They believe that one needs to invent new ideas, which will help us to overcome problems of the contemporary theoretical physics. Overcoming of AD.7 showed discovery of associative delusions in the fundament of the theoretical physics and their overcoming is most important problem of theoretical physics, which may change direction of fundamental investigation.

Let me describe how I succeeded to overcome AD.7. This overcoming took place in 1970. Description of this overcoming is interesting from the viewpoint, how difficult this overcoming is for the scienrific community. This overcoming was carried out consciously on basis of understanding that in the relativistic theory a physical object is world line (WL)[2], but not a pointlike particle in the three-dimensional space. I took this truth from the book of V. A. Fock. [30]. Later I found confirmation of this viewpoint in papers of Stueckelberg [31] and Feynman [32]. In general, such a viewpoint was in keeping with my style of geometrical thinking. This brought up the question: "Is it possible to describe pair production in terms of classical relativistic mechanics?" The pair production process is described by a turn of a world line in the time direction. It was well known. It was necessary to invent such an external field which could carry out this turn. It was clear, that adding an arbitrary field to the action of charged particle in a given electromagnetic field A_i

$$\mathcal{A}[q]=\int\left\{-mc\sqrt{g_{ik}\dot{q}^i\dot{q}^k}+\frac{e}{c}A_i\dot{q}^i\right\}d\tau,\quad \dot{q}\equiv\frac{d\dot{q}}{d\tau} \tag{6.4}$$

one could not carry out such a turn. The fact is that, at the turn in time the world line becomes to be spacelike near the turning point. On the other hand, under the sign of radical in (6.4) must be a nonnegative quantity. It means, that $g_{ik}\dot{q}^i\dot{q}^k\geq 0$ and, hence the world line is to be timelike (or null). In order the world line might be spacelike, the external field is to be introduced under sign of radical in (6.4). Then the expression under sign of radical may be positive even in the case, when $g_{ik}\dot{q}^i\dot{q}^k<0$. I introduced the external field under the sign of radical, writing the action in the form

[2]designations WL is used for the world line, considered as a fundamental object

$$\mathcal{A}[q]=\int\left\{-mc\sqrt{g_{ik}\dot{q}^i\dot{q}^k-\alpha f\left(q\right)}+\frac{e}{c}A_i\dot{q}^i\right\}d\tau, \quad (6.5)$$

where f is an external scalar field, and α is a small parameter, which tends to zero at the end of calculations. At the properly chosen field f the expression under the radical can be positive even at $g_{ik}\dot{q}^i\dot{q}^k<0$. It appeared that at the properly chosen field f, the world line turned in time indeed. This turn is conserved at $\alpha\rightarrow 0$. The direct calculations [28] showed that at such a description the particle energy was positive always, but the time component p_0 of the canonical momentum and the particle charge $Q=e\mathrm{sgn}(\dot{q}^0)$ depended on sign of derivative $\dot{q}^0$, i.e. they were different for particle and antiparticle. It was rather sudden that the WL charge Q, defined as a source of the electromagnetic field by the relation $Q=\int\delta\mathcal{A}/\delta A_0(\mathbf{x})d\mathbf{x}$, did not coincide with the constant e, incoming to the action, although at the correct description this was to be just so, because the particle and antiparticle had opposite sign of the charge. One can obtain coincidence of energy E and p_0, if one cuts the whole world line into segments, responsible for particles and antiparticles, and changes the sign of the parameter τ on the segments, responsible for antiparticles, remaining τ without a change on segments, responsible for particles. After change of the τ sign the segments with changed τ ceases to be a solution of dynamic system (6.5). The particles and antiparticles become to be described by different dynamic systems.

This simple example shows, that there are two possibilities of description

(1) To consider the world line (WL) to be a physical object. Then particle and antiparticle are two different states of WL, distinguishing by signs of the charge Q and by signs of the canonical momentum component p_0. The energy is positive in both cases, so restriction $E = H$ is not used.

(2) To consider the particle and the antiparticle to be different physical objects, described by two different dynamic systems. In this case one uses restriction $E = H$.

Imposition of the constraint $E=H$ provided automatically fragmentation of the world line into particles and antiparticles, describing them as different physical objects, i.e. in terms of different dynamic systems. This was valid in classical physics. This must be valid in the quantum theory.

It was unclear for me, what was a use of the identification of energy with Hamiltonian. Why does one cut WL to obtain indefinite nonconservative number of particles and antiparticles instead of fixed number of physical objects (WL)? From the formal viewpoint it is more convenient to work with constant number of objects, than with alternating number of them. It was evident for me, that impossibility of working in QFT without the perturbation theory was connected directly with the fact that numbers of particles and antiparticles were not conserved separately. What for does one need to impose the condition $E = H$ and to restrict one's capacity, if one could impose no constraints? (Then I did not consider, that the condition $E = H$ might appear to be incompatible with dynamic equations).

It was necessary to discuss the paper with colleagues dealing with QFT, and I submitted my report to seminar of the theoretical department of the Lebedev Physical Institute, where there were many good theorists. At my report at the session I was surprised by the following circumstance. Nobody believed that the pair production effect could be described in terms of classical mechanics. Although my calculations were very simple, they cast doubt on their validity. It was decided to transfer my report to next session. One of participants of the seminar was asked to verify my calculations and to report on the next session together with continuation of my report. Mistakes in my calculations were not found, and I completed successfully my report at the next session. After the session I seemed that the attention of participants of the seminar was attracted to the problem of possibility of pair production description in terms of classical physics, whereas the main problem, i.e. application the constraint $E = H$ in QFT, remained outside the scope. Corresponding my paper was published [28], but, as far as I know, nobody payed any attention to it.

It was necessary to quantize nonlinear relativistic field without a use of the condition $E = H$ and to verify, if such a way of quantization had advantages over the conventional way, using this condition. It happened that such a quantization could be carried out without a use of normal ordering and perturbation theory [7]. The vacuum state appeared to be stationary. A possibility of quantization without the perturbation theory impressed. But I shall not be cunning and say directly, that I had no illusions about results of my work. In that time (beginning of seventieth) I assumed that the problem of the quantum mechanics relativization (i.e. unification of quantum theory with the relativity theory) had no solution. I assumed that the quantum mechanics was something like relativistic Brownian motion, and the relativistic quantum theory should be developed in direction of statistical description of this relativistic motion [2].

My work on the secondary quantization of the nonlinear relativistic field was undertaken with the goal to manifest that the conventional way of the QFT development was a way to blind alley. The logic of my action was as follows. One quantizes the nonlinear field, using only principles of nonrelativistic quantum mechanics and ignoring any additional suppositions. One advances as far as possible. There were a hope that the quantization without the perturbation theory admitted one to clarify real problems of QFT and, maybe, to solve some of them.

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The fact was that the use of the perturbation theory did not permit one both to state exactly problems of QFT and to solve them. The problems of collisions were the main problems of QFT. To state the collision problem, it was necessary to formulate exactly what was a particle and what was an antiparticle. According to quantum mechanics principles it is necessary to define for this the operator N_{p}^{i} of the 4-flux of particles and the operator N_{a}^{i} of the 4-flux of antiparticles. After such a definition one can state the problem of collisions. Surprisingly, it appeared that nobody tried to introduce these operators. Instead of this there were cloudy consideration about the interaction cut off at large time $t\rightarrow\pm\infty$. Thereafter these considerations about cut off were substituted by manipulations with in- and *out*-operators, that did not clarify the statement of the collision problem.

Even in the excellent mathematically rigorous book by F. A. Berezin [33] the collision problem was stated in terms of perturbed *H* and nonperturbed H_0 Hamiltonian H_0 describes the dynamic system, that corresponds to interaction cut off at $t\rightarrow\pm\infty$. Of course, all this was only a re.ection of the whole situation in QFT. I asked my colleagues dealing with QFT, how could one think in terms of the perturbation theory. They answered obscurely. I understood, that some problems could not be solved exactly. I was ready to use any methods of approximation (including the perturbation theory) by the indispensable condition, that the problem be stated exactly, but not in approximate terms. To state a problem in approximate concepts and terms was beyond my understanding.

As soon as the nonlinear field was quantized [7], results of my paper were reported on a session of the seminar of the theoretical department of Lebedev Physical Institute. Although the secondary quantization was produced without the perturbation theory, most of participants considered my results to be unsatisfactory on the ground that at the quantization one violated the condition

$$[\varphi(x),\varphi^{*}(x')]_{-}=0,\quad (x-x')^{2}<0 \qquad (6.6)$$

which was interpreted usually as the causality condition. Indeed, if at the quantization the condition *E* = *H* is not imposed, the commutator between the dynamic variables at the points, separated by a spacelike interval $x-x'$cannot (and in some cases must not) vanish. Let me explain this in the example of pair production, described in terms of classical physics, where the pair production is described by time zigzag of the world line. In this case the commutator (6.6) associates with the Poisson bracket. If the condition *E* = *H* is imposed and the quantization is carried out in terms of particles and antiparticles, the dynamic variables X and X' at the points, separated by a spacelike interval $x-x'$, relate to different dynamic systems always. The corresponding Poisson bracket$\{X,X'\}$between any dynamic variables X and X' at these points vanishes. In the case of quantization in terms of world lines the dynamic variables X and X' at the points, separated by a spacelike interval $x-x'$, can belong to the same world line, i.e. to the same dynamic system. Then the variables X and X' correspond to different values τ and τ' of evolution parameter τ. In this case the dynamic variables X at the point x are expressed via dynamic variables X' at the point x', and there exist such a dynamic variables X_1 at x and X_2' at x', that the Poison bracket$\{X_1,X_2'\}$does not vanish. The condition (6.6) is violated with a necessity.

Thus, a fulfiillment or a violation of the condition (6.6) is an attribute of a description. It coincides with the causality condition (i.e. with the objectively existing relation) only at imposition of the condition *E* = *H*. Unfortunately, I failed to convince my opponents of dependence the relation (6.6) on the way of description, although I tried to do this at the session and in discussions thereafter. Later on I had understood, that in this case one met associative delusion, when the properties of description are attributed to the object in itself. Unfortunately, it happens that many researchers meet difficulties at overcoming of AD, and as I am understanding now, the P-style used by the most researchers of QFT is a reason of these difficulties. Besides, formulating the condition (6.6) in terms of quantum theory, it is very difficult to discover that this condition is an attribute of a description, but not a causality condition.

Thus, I had overcame AD.7, but the scientific community as whole had not overcame it. I did not see a necessity in further convincing my colleagues to refuse from imposition of the condition *E* = *H* at quantization. At first, I was convinced that the refusal itself from *E* = *H* did not solve main problems of QFT. My belief, that QFT did not enable to solve the unification problem of quantum theory with relativity and that the statement of this problem was false in itself, became stronger. Secondly, I myself did not know exactly what must replace this problem of unification. I had only a guess on this account. I might not to convince a person, dealing with QFT and devoting essential part of his life to this, that he had chosen a wrong way. Without pointing a right way, such a convincing was useless.

There were once more an important circumstance which influenced strongly on my interrelations with colleagues dealing with QFT. The fact is that, since I had discovered incorrectness of imposition of the condition *E* = *H*, I met difficulties at reading papers on QFT. When I began to read any paper and discovered that the condition *E* = *H* was used there (this was practically in all papers on QFT), my attention was cut off subconsciously, and I could not continue conscious reading. My reading became absent-minded, and I needed to bend my every effort to turn on my attention and continue a conscious reading. I

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do not know to what extent such a reaction is my individual property, but tearing off the papers using $E = H$ led gradually to my allergy to reading of papers on QFT. I stopped to read them, although I was interesting QFT always, and questioned my colleagues about QFT development at any suitable case.

Why did I overcome associative delusions comparatively easy? Apparently, it was connected with that I was an adherent of the C-style and ignored instinctively approaches, which were used by the P-style. It is difficult for me to say, whether this adherence to the C-style was innate, or it was a result of my education.

At first I did not think on styles of investigations. I assumed simply, that one needed to investigate a physical phenomenon honestly, but not to dodge, substituting calculations by conjectures. Maybe, my instinctive adherence to the C-style was so large, that penetrated to my subconsciousness and generated allergy to reading papers on QFT.

Maybe, my successes in overcoming of different ADs was conditioned by consecutive application of C-style, essence of which could be expressed by the Newton's words: "I do not invent hypotheses"

VII. On Styles of Investigation

Considerations of the conventional investigation style look approximately as follows. Let us introduce an additional supposition and study its consequences for theory and experiment. If the consequences are positive, the additional supposition is accepted and introduced into the theory. If the consequences are negative, the additional sup-position is removed and a new additional supposition is considered. Such additional suppositions were: normal ordering, renormalizations, increase of the space-time dimension with the subsequent compactification, strings, etc. This style of investigation: additional supposition with subsequent test of its consequences will be referred to as P-style (pragmatic style) of investigation. Such a style is characteristic not only for the QFT development. In the beginning of XX century the quantum mechanics development was carried out also by means of P-style. The quantum mechanics developed, fighting against the classical style (C-style) of investigations, established to the end of XIX century. In this fight the P-style gained a victory over the C-style, which played a role of representative of classical (nonquantum) physics. Successors of Ptolemeus used the P-style, whereas successors of Copernicus used the C-style. The competition of successors of Ptolemeus with the successors of Copernicus was at the same time a competition between P-style and C-style. Then the C-style gained the victory. C-style reached its fullest flower to the end of XIX century. At the investigations of quantum phenomena in the XX century C-style gave the way to P-style.

Why do two different styles of investigation exist? Why does the investigation C-style or the investigation P-style gain alternatively the competition? The answer is as follows.

C-style is a style of investigations in the framework of a consistent theory. It puts in the forefront the consistency of a theory. C-style restricts suggestion of additional suppositions (hypotheses), insisting, that additional suppositions be consistent with primary principles of a theory. (Let us recall the Newton's words: "I do not invent hypotheses"). In virtue of its requirement rigidity the C-style has the more predictable force, than the P-style, where these requirements are not so rigid. Among the C-style requirements there are ethic requirements to researchers. For instance, a researcher, which publishes insufficiently founded paper, containing arbitrary (i.e. not following from the primary principles) suppositions, risks losing his scientific face.

Adherents of the C-style pay attention to fundamental problems of a theory, and in particular, to results and predictions of the theory, which are important for its further development. Solutions of concrete practical problems are considered to be not so important, because a solution of any special problem is a formal application of primary principles and mathematical technique to conditions of the new problem, and nothing beyond this. Such a relation of the researcher, using the C-style, to a solution of special problems is founded on his confidence that the primary principles are valid and the theory is consistent.

The predictability of the C-style, rigidity of its requirements and its self-reliance are true, provided the primary principles of a theory are true. If the primary principles contain a mistake, some predictions of the theory appears to be false. It forces onto searching for a mistake, which may occurs in the primary principles or in the conclusion of corollaries from them. The most frequently a mistake is discovered in incorrect application of the primary principles.

But if the mistake in conclusions of a theory (discrepancy between predictions of the theory and experiment) has not been discovered for a long time, the necessity of the cognition progress and necessity of improvement of the terminology for the experimental data description generate a more pragmatic style (P-style) of investigations.

The P-style puts in the forefront a possibility of the experimental data explanation, what is obtained usually by introduction of additional suppositions. The theory consistency is considered to be not so important, although the representatives of the P-style declare, that they tend to elimination of inconsistencies, but it does not succeeded always, and it is considered to be a less defect, than impossibility of the experiment explanation. The P-style admits an introduction of additional

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suppositions, even if they appear to be inconsistent with primary principles. It is important only, that they were useful and led to explanation of experimental data. The P-style imposes essentially more slight requirements to researchers. For instance, the scientific reputation of a researcher does not lack or lacks slightly, if writing a very good paper, he writes thereafter several mediocre or even incorrect papers. Predictability of the P-style is essentially less, than that of the C-style, as far as P-style admits only a "short logic"(short logical chain of considerations). For instance, it is widely believed among researchers dealing with quantum theory that essentially new result can be obtained, only suggesting some essentially new supposition in the framework of quantum theory. The idea that a novelty may be found in the primary principles (i.e. outside the framework of quantum theory) and the new result is a corollary of a long logical chain of considerations is perceived as something unreal.

Pragmatism of the P-style manifests itself in setting in the forefront a solution of concrete practical problems. It is supposed that a young talent gifted researcher is to solve concrete problems, whereas solution of fundamental problems is supposed to be a work for elderly experienced researchers. According to such a viewpoint usually one ignores and does not discuss facts and results which are important for further development of a theory, but which do not deal directly with its practical applications. Behind such a relation one can see an uncertainty of the P-style representatives in the primary principles of a theory and in its consistency. If a practical problem fails to be solved, the P-style representatives are ready to suggest additional suppositions and even to revise the primary principles.

The P-style appears to be more effective, only if the C-style appears to be in-effective. The last takes place, if the primary principles contain either mistake or defect. In other words, the C-style is more effective, than the P-style only at absence of obstacles (systematic noise). The P-style is noise-resistant, under presence of the "systematical noise" it appears to be more effective, than the C-style. In the period of a long P-style dominance a theory degenerates. Accumulating many additional suppositions, contradicting each other, the theory gives up step-by-step its predictable force and capacity of valid development. Situation was such in the time of dominance of the Ptolemaic doctrine. The same situation takes place now in the quantum field theory.

In general, the C-style is more effective and predictable, provided the primary principles are valid. The P-style is useful in the relation, that it works even in the case, when there is a mistake in the primary principles, and C-style cannot work. In this case the P-style admits one to introduce new adequate concepts and terminology for descriptions of experiments that cannot be explained by the theory, based on the primary principles. Finally, investigations, realized by means of the P-style, help one to discover mistake in the choice of primary principles and produce a necessary revision.

Any style of investigations is conservative. It is worked out by a researcher in the course of all his research activity. If the researcher used the P-style, i.e. he uses essentially the trial and error method, he gets accustomed hardly to rigid restrictions of the C-style. Vice versa, a researcher, using the C-style in his work, gets accustomed to work with consistent conceptions. It is very difficult for him to pass to more free P-style and to invent new additional supposition which are necessary for explanations of new experiments. Conservatism of the investigation style leads to a confiict, when the dominating investigation style changes. For instance, in the time of Ptolemeus the P-style dominated. Discovery of AD.2 needed to construct a consistent conception of the celestial mechanics which would be free of arbitrary sup-positions. The confiict between the successors of Ptolemeus and those of Copernicus was in the same time a conflict between the investigation styles.

Now practically all researchers dealing with relativistic QFT use P-style. They perceive difficultly arguments of the C-style proponents, having found inconsistencies and mistakes in primary principles of the quantum theory.

To describe my research activity briefly, one should say, that using *C-style, I put consecutively into effect the idea of geometrization of physics* [34], and this agreed completely with the general line of the physics development in XIX .XX centuries.

VIII. Overcoming of Associative Delusions in the Contemporary Theoretical Physics

Lee Smolin formulated five unsolved important problems of contemporary theoretical physics [13]:

Problem 1: Unification of general relativity and quantum theory (quantum gravitation)

Problem 2: Rationale of quantum mechanics.

Problem 3: Unification of particles and fields.

Problem 4: Explanation how to choose free constants in the standard model of elementary particle physics.

Problem 5: Explanation of the phenomenon of dark matter and dark energy.

Lee Smolin supposed that these problems should be solved in the framework of a constructing theory (a theory developed by the P-style). However, discovery of AD.4-AD.7 and overcoming of them admits one to solve all these problem, using C-style of investigation. In reality, only AD.5 and AD.4 are used in solution of these problems. AD.6 and AD.7 are specific associative delusions of the quantum theory. They are not used, when overcoming of AD.5 admits one to found quantum mechanics and to solve the second problem of Smolin. Foundation of quantum mechanics as a statistical description of classical stochastic particles solve the first Smolin problem, because in the framework DCSD the gravitational field is not to be quantized. The first problem of Smolin does not exist simply. The third problem exists also only in the framework of quantum theory. The fourth problem is a specific problem of the standard model. It is absent in the skeleton conception of elementary particles [35]. The fifth problem is solved by discovery and overcoming of AD.4. As a result the general relativity is extended on the case of physical space-time geometries [36]. In the extended general relativity there are no dark holes, because the collapse of stars and other cosmic objects stops by the induced antigravitation [37]. Antigravitation is absent in general relativity. As a result one is forced to invent the dark energy, to explain the advanced expansion of universe. In the extended general relativity there is antigravitation, and there are no reason to invent the dark energy.

As to dark matter, it is the tachyon gas. Overcoming of AD.4 admits one to consider the geometry of Minkowski as a physical geometry, where spacelike vectors are multivariant. Then tachyons exist, but a single tachyon cannot be detected, because of infinite amplitude of its world line wobbling. However, the tachyon gas can be detected by its gravitational field [38]. The tachyon gas forms the dark matter [39].

Thus, overcoming of associative delusions admits one to solve important problems of theoretical physics. It appears that there are defunct problems (like the problem 1). It is the problem only from the viewpoint of researchers, using P-style. Besides, there are problems generated by the suppositions generated by associative delusions.

IX. Concluding Remarks

Thus, the associative delusions (AD) accompanied the cognition process. Although one should tend to eliminate ADs, but, apparently, the complete elimination of them is impossible. In the case of impossibility of this elimination of ADs, AD leads to appearance of additional compensating hypotheses and to a construction of compensating (Ptolemaic) conceptions. Appearance of Ptolemaic conceptions leads to a generation of a special P-style of investigations, suitable for work with Ptolemaic conceptions. The P-style is simultaneously a style of investigations and a style of thinking. On one hand, the P-style is "noise-resistant"(suitable for work with Ptolemaic constructions, containing false suppositions), but on the other hand, it is less predictable, than C-style. In the course of some time one can pursue investigations, using P-style. But, thereafter the Ptolemaic conceptions stops to be effective. It becomes necessary to find and to overcome corresponding AD, returning to C-style. If the P-style was existing for a long time and several generations of researchers had educated on its application, the overcoming of AD and returning to the C-style will be a difficult process. One needs to be ready to this.

After discovering AD the subsequent revision of existing theory may appear to be very essential. If it concerns the space-time geometry, the revision may lead even to a change of a world outlook. Transition from the space-time with the primordially deterministic particle motion to the space-time with the primordially stochastic motion is already a ground for a change of the world outlook. If earlier it was necessary to explain the stochasticity, starting from the determinism of the world, then now one should explain deterministic phenomena on the basis of primordial stochasticity of the world.

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