

**TARAS ABZIANIDZE**

**CRITICISM OF NEWTON'S LAWS AND  
CONSTRUCTION OF KEPLERIAN  
ELLIPSE**

**EINSTEIN'S SPECIAL AND GENERAL  
THEORY OF RELATIVITY**

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## FROM THE EDITOR

From time immemorial, man tries to understand the world around him and create a picture of the Universe on the basis of intuition and the knowledge he possessed at that time. With increasing volume of knowledge, the picture of the Universe was changing still preserving a particle of truth. Even the first picture of the Earth on three whales or three elephants contains a particle of truth – the Earth is of finite size. According to Ptolemy, one celestial body was orbiting another. In Newton’s celestial mechanics celestial bodies interact.

The emergence of new fundamental ideas of the scientific universe is always associated with the struggle of different notions about the structure of the surrounding world. Such was the case for the “Special Theory of Relativity” (STR) which denied the existence of universal ether, and “General Relativity” by Albert Einstein, which rejected Newton’s celestial mechanics. This mechanics, unlike Einstein, but for entirely different reasons, and Einstein’s picture of the Universe was also rejected by a schoolteacher Taras Abzianidze, who lived in Tbilisi, the capital of the Georgian Soviet Socialist Republic, and worked successfully to enhance the physical science in his country [1, 2]. Since the first quarter of the twentieth century until recently, Einstein’s picture of the Universe was officially considered as the basis of all scientific worldview. At present, many scientists, based on new experimental data, categorically deny the correctness of these theories. Moreover, they point to their negative role in the development of science and technology [2, 3, 4]. The same uncompromising position, but eighty years ago, during the total domination of this worldview, was taken by Taras Abzianidze. With extensive knowledge in various fields of science

and mental power not inferior to that of the science luminaries, he clearly saw the failure of these theories and alone proved it diligently by scientific reasoning. Paying tribute to the genius of Newton's intuition who wrote correct mathematical formulas for planetary motion, Mr. Taras Abzianidze firmly opposed the existence only of the attractive force without repulsion, and relying on well-known mechanics works proved it in his book "The criticism of Newton's laws and the construction of Kepler ellipse." He showed clearly that using three of Newton's laws and the law of gravity, Kepler elliptical orbits cannot be obtained without allowance for repulsion. But the forces of attraction and repulsion are inherent in oscillatory motions which, by his opinion, were innate characteristics of all movements of matter. Thus, the motion of celestial bodies in elliptical orbits is the result of the addition of their oscillatory motions. But this simple logical conclusion was prevented by the existing opinion that the construction of the Kepler ellipse from oscillatory motions was impossible. Mr. Taras Abzianidze proved mathematically that Kepler elliptical orbits can be obtained by addition of several oscillatory motions.

For Taras Abzianidze the basis of rejection of both Einstein's theories was their artificiality, their isolation from the real nature and the lack of arguments to prove their correctness. "Mathematics cannot be responsible for the essence of some key principles divorced from the objective material reality; ... With the wrong postulates and incorrect prerequisites the result is wrong, incorrect, obscure, in spite of the correct mathematical treatment of the issue." He was strongly against Einstein's approach to the description of the objective material reality, that "a theory must be build speculatively and then with the help of more or less artificial additional postulates be adapted to the experimental facts," or "if you do not sin against reason, you cannot come to anything". Basing on the actual material, Taras Abzzianidze illustrates the absence of arguments to prove the correctness of the two theories of Einstein, and shows that all these arguments were received in the framework of classical physics long before Einstein, for example, the

famous formula  $E=Mc^2$  unjustly attributed to Einstein, has been derived earlier by Joseph Thomson. Taras Abzianidze presented reports to the academic audience of the Institute of Physics, Astronomy and Mathematics of the USSR Academy of Sciences in Tbilisi, Leningrad (now Sankt-Peterburg), in Moscow. From the minutes, transcripts of meetings and report reviews it is clear that despite the lively exchange of views, there were no the principal objections to the arguments of the reporter, but, for obvious reasons (see below) there was no declared agreement with them. There was only “a wish to publish these reports for public discussion”, which resulted in writing of two books: “Criticism of Newton’s laws and the Construction of Kepler Ellipse” and “On Some Methodological Problems of Science. On the Special and General Theories of Relativity of Einstein”. But, as noted in [2], since “as far back as 1934, the Resolution of the Central Committee of the CPSU (b) “On the discussion of relativism” was adopted, according to which one could be condemned to penal servitude in camps for criticism of the theory of relativity”, his second book was not published during his lifetime, and the first book which did not contain any explicit criticism of Einstein, was published in 1961 when the winds of post-Stalin freedom were blowing rather tangibly, and his brother Vladimir (Ladiko) Abzianidze occupied a high position in the government of Georgia. I think that Taras Abzianidze escaped from sever persecution due to the fact that he did not have any academic ranks and high-profile titles, and that there was no declared agreement with his ideas of those who knew well how it all might end! It should be noted that Taras Abzianidze proved the incorrectness of Newton and Einstein’s patterns of universe in order to offer his own pattern, based on the ideas of the ancient philosophers, which he described in his first book after criticism of Newton. In short, it comes to the fact that we can definitely state that all natural – free motion of planetary bodies, molecules, atoms, electrons and other elementary particles of modern physics, is a periodic oscillatory motion with all its laws, and these oscillating movements are not considered as so-called “force “, but as the simplest basic form of motion of matter.

On the basis of these ideas he formulated the first law of dynamics – the law of inertia, as follows: “Any free body maintains a state of periodic oscillatory motion until an external cause forcibly brings it out of this state”. It would be logical to present it already after criticism of Einstein, at the end of the second book, or to devote a separate book to it, but there was little hope that he would be able to do it in his lifetime, and he felt it necessary to fix his point of view! It should be noted that the title of the second book is wider than the criticism of Einstein’s theory. This, in our opinion, is due to the fact that Taras Abzianidze was probably going to examine other examples of misleading the intellectual community. Our assumption is supported by the fact that in the manuscript of the book, after the title, a postscript is given: “reduced by 50%”. Unfortunately, the continuation of the manuscript has not been found. Taras Abzianidze disputed not only the abstract description of Einstein’s picture of the world, but also the “compulsion to recognize” new discoveries in science worked out after the widest unfair recognition of Einstein’s theory, as well as the mutual admiration of popular authorities that, in his opinion, “bewilders the youth and they do not even think of looking for something creative in addition to these “figurants” of science and fleeting advertisements ...”.

Based on the foregoing, the relentless struggle of Taras Abzianidze for scientific truth was really not only a scientific but also a civil feat! And he appears to us as a great thinker, comparable in power with Einstein, whom he highly appreciated and criticized so gracefully! Mr. Taras, as if anticipating his future, wrote bitterly about those scientists who have made a significant contribution to science, but for various reasons were not understood by their contemporaries, or were robbed or undeservedly forgotten. The latter almost happened with him, but thank God, after half a century of neglect, through the efforts of the relatives, his name returns to its deserved place. Here, special thanks can be given to his grandson, the well-known urologist, Professor George Zhvania, by whose efforts the first book of his grandfather was republished and the second book was published in the Russian and English languages. This is not only a tribute of respect



and love for a dear person, but also a deed of the universal value, since he acquainted a thinking community with one of the great thinkers of the twentieth century – Taras Abzianidze!

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3. Smirnov A.P. Prohortsev I. V. – “The principle of Order.” – SPb. 2002 (divu, Russ.)
4. Atsyukovsky V. A. – Editor of a collection of articles “Ethereal Wind”. – 1993.

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*P. S. The book preserves an original way of citation used by the author in the manuscript, for example, [196<sup>50</sup>] 50 is the sequence number of references, and 196 – the page in it.*



**CRITICISM OF NEWTON'S LAWS AND  
CONSTRUCTION OF KEPLERIAN  
ELLIPSE**



## INSTEAD OF PREFACE

The first edition of this work “Criticism of Newton’s laws and construction of Keplerian ellipse” was printed in 1934 and sent to the Institutes of Physics and Astronomy of the Academy of Sciences of the USSR as well as to competent specialists.

In 1938, 1948, 1950 I spoke with the reviewers of my work in Tbilisi and Moscow.

In 1938 at the meeting of the special Commission of the Georgian branch of the Academy of Sciences of the USSR consisting of five professors, and in 1949 in Leningrad, at the enlarged meeting of the Academic Council of the Institute of Theoretical Astronomy of the Academy of Sciences of the USSR, my report “On the force of universal gravitation”, i.e. the first part of the work, was presented.

At both meetings, the report provoked a lively exchange of opinions.

All existing reviews of the Institutes of Physics, Mathematics, Astronomy of the Academy of Sciences of the USSR and the Georgian SSR, personal communication with reviewers and discussions in Tbilisi and Leningrad convinced me and my reviewers in publishing my work for the purpose of extensive debate (see extracts from minutes, shorthand records of the meetings, and reviews).

In this regard, in the new edition (1961), yielding to the request of the experts, the work had to be split into two parts.

In the first part of the work, those mathematical conclusions were left which cannot be misunderstood or misinterpreted. To reduce the amount of this part of the work, some paragraphs were moved to the second part.

As a result of these changes, the first part of the work “On the force of universal gravitation” is reduced to three chapters.

The first chapter deals with Newton's force of universal gravitation together with differential equations of planetary motion and Kepler's three laws.

By mathematical analysis it is determined that the physical interpretation of the elliptic shape of planetary orbits as the force of gravitation to the center, according to Newtonian mechanics, and inertial motions are inconsistent with and contrary to the mathematical derivations of the elliptical shape of the planetary orbits given by Newton.

The rigorous mathematical analysis shows that practically justified differential equations of planetary motion in the solar system are the equations of oscillatory motion and have nothing to do with the Newton's force of universal gravitation.

It is derived mathematically that all Kepler's three laws are a necessary consequence of the oscillatory motion and are obtained by addition of oscillatory motions.

At the same time it is proved that the Sun cannot have any attractive force, and instead of a mysterious tangential force carrying the planet away in the direction perpendicular to gravity, a motion of central character – repulsion is obtained.

All this mathematical side of the question finds explicit confirmation in philosophy, namely, in dialectical materialism, according to which the main form of motion of matter is attraction – repulsion, approach-separation; and the theory of matter based on the principle of attractive force is false, while the Newtonian law of gravitation is an example of metaphysical thinking (see Hegel, Kant, Engels).

In the second chapter, some basic questions of celestial mechanics: the shape and inclination of the orbit, the rotation of line of apsides in terms of oscillatory motion, and some facts of discrepancy between the theory of gravitation and the reality are discussed.

The rest issues of celestial and terrestrial mechanics are considered more comprehensively in part II. This is a problem of Einstein's gravitational theory, a problem of uniform motion, gravitational field and acceleration of a free

falling body, a problem of “entropy” and “unity of the Universe”, “mass and energy”, Bertrand’s problem, problems of tides, as well as Bode-Titius law.

The problems of Kepler’s third law and of the rotation of the line of apses of Mercury are also considered, and an overview of the teachings about the world system of Ptolemy, Copernicus, Kepler, Newton and Einstein is given.

In the third chapter, contrary to the view accepted in science that the Keplerian ellipse cannot be constructed from oscillatory motions, a mathematical proof of the possibility of constructing the Keplerian ellipse with all its specific properties on the basis of the laws of addition of oscillatory motions is given.

Solving this problem, i.e. expressing all planetary mechanics by mathematical equations of oscillatory motions, we introduce into science the unity of understanding of all physical phenomena, i.e. “the unity of the Universe,” the unity of the material world or, according to Kepler, “the harmony of the world”, and according to A. Einstein - “ the unified field theory” – the idea that is recognized by all scholars of the ancient and new world.

“... Many attempts were made to evaluate universal gravitation as the electromagnetic phenomenon, but they all failed... Except for gravity, all other forces of the material universe... are of electromagnetic nature” (see Lincoln Barnett, *The Universe*, and the works by Dr. Einstein), i.e., according to D. Bernoulli, they are “a mixture of simple regular and persistent oscillations of different nature” (see D. Bernoulli, *Histoire de l’academie de Berlin*).

All the phenomena of planetary motion in the solar system considered as oscillatory motion showed that there were no contradictions to the extent they were developed. But can we be sure that at subsequent stages no discrepancies will occur, at least in the definition of “true orbits” in celestial mechanics and generally in whole physics? Is there an absolute guarantee of perfect mathematical accuracy of the well-developed concept of the world outlook?

The great scientists – Descartes, Newton, Helmholtz, Leibniz, Fourier, Euler, Gauss, etc. gave analytical methods for studying kinematic properties of a moving body. These methods imply that all correlations between kinematic elements of the moving body can be expressed in the form of the equations relating them; the further study of the kinematic elements – changes in

the path, velocity and acceleration of a moving body becomes a matter of algebra and analysis – drawing conclusions that follow from these equations.

On the other hand, a more comprehensive study of the kinematic and geometric elements of a moving body is carried out by means of the calculus of infinitesimal quantities, i.e. the definition of integral curves based on the properties of the oscillating system; in other words, the differential equation describing the behavior of the system can be integrated depending on the store of energy possessed (or received) by the system.

Further development of this concept of worldview in terms of the “perturbed motions”, i.e., the true orbits and the motion of bodies on the earth’s surface, cannot lead to any contradiction, because this contradiction is absent in those equations that express basic relations between kinematic and geometric elements of the moving body, and from these relations all other kinds of motion both on the earth’s surface and in celestial mechanics are derived.

Here, it should be borne in mind that the “perturbed motion” of the planets can be considered as an unperturbed motion, all the elements of which are continuous time functions (see Duboshin, *Introduction to Celestial Mechanics*, p. 137), and the differential equations in the astronomical theory of “perturbed motions” solved by the methods of Linstedt, Hilden, Bohlen, etc., are the equations of nonlinear oscillatory systems” (see N. M. Krylov and N. N. Bogolyubov, *Introduction to Nonlinear Mechanics*). Similarly, the determination of the orbits planetary satellites solved by the methods of Euler, Hill and Adams are the equations of oscillatory motions (see L. Euler, *New Theory of Moon Motion*).

Consequently, the determination of the orbit of “perturbed motion”, where all kinematic and geometric elements must be associated with the elements of unperturbed motion, is a matter of analysis, where all calculations should be consistent with each other and could not be able to open anything new that is not involved in those solved equations from which all relations of kinematic and geometric quantities of a moving body should be taken.

If later we find any discrepancies in the considered concept of worldview, they must be sought in the equations rather than in the accepted con-



cept based on the dialectical laws of nature and on the idea of “unity of the Universe”.

The foregoing is perfectly confirmed by the fact that the great thinkers of the ancient and the new world – Pythagoras, Empedocles, Democritus, Aristotle, Descartes, Kant, Hegel, Engels and others regard matter as a unity of attraction and repulsion.

If Ptolemy’s concept of the world based on the principles of Aristotelian philosophy could survive for 1600 years, and Newton’s concept of the world based on metaphysical materialism - 300 years, one can be sure that the proposed concept of the world will develop constantly, because it is based on the scientific method of thinking – on dialectical materialism, according to which the proposed conception of the world reflects the objective law of nature, rather than something subjective (Ptolemy), isolated (Newton), random (Einstein), which is temporary, transient, and thanks to which old theories were destroyed.

Therefore, one can be firmly convinced that the proposed concept of worldview will not face the fate of Ptolemy’s, Newton’s and Einstein’s worldview, but will be subject to superstructure and development.

Tbilisi, 1961 r.

**T. S. Abzianidze**

## ANNOTATION

1. Physical interpretation of the elliptical figure of the orbit of planets according to Newton mechanics, as attraction to the fixed (immovable) centre and movement under its own momentum, does not coincide with mathematical conclusions of the elliptical figure of the orbit of planets drawn by Newton himself, and even contradicts them.

2. Exact mathematical analysis shows that practically correct differential equations of the movement of the planets of the solar system express not the law of attraction (gravity) and inertia but real dialectical laws of nature – attraction – repulsion, viz they represent equations of oscillatory movements.

3. According to mathematical analysis Kepler's three laws and all the laws of planetary mechanics are the necessary consequence of oscillatory movements, and they are received by the composition of oscillatory movements.

4. The opinion established in science that it is impossible to receive Kepler's ellipsis from oscillatory movements, is wrong. This paper shows that Kepler's ellipsis is possible to receive only from oscillatory movements.

Moreover the given paper shows that the sun cannot exert any gravity, and instead of some mysterious tangential force, that drives the planet in the direction perpendicular to gravity (attraction), movement of central character is received it is repulsion.

5. This mathematical side of the questions find its clear and definite justification in philosophy, viz. in dialectical materialism, according to which, the principal form of movement of matter is – attraction – repulsion.

The theory of matter based on the gravity principle is wrong, and Newton's law of universal attraction is an example of metaphysical thinking (see Kant, Hegel, F. Engels).

6. Several attempts were to connect the universal attraction with electromagnetic phenomena, viz. with oscillatory movements, but up to this time they were all failures (see Lincoln Barnett "The Universe and the works of Dr. Einstein", 1948).

7. Now, when it is proved in the paper, that not only the interaction of bodies on the surface of the earth (see D. Bernulli "Histoire de l'academie de Berlin", 1753) but the whole planetary mechanics is subjected to the laws of oscillatory movements, we can unite classical physics with quantum physics, and thus penetrate into the structure of the elementary particles of the atom more deeply.

8. The following facts speak in favour of this statement: having expressed attraction and repulsion the bases of the universe – by the same mathematical equations of oscillatory movements, we introduce united understanding of all physical phenomena in the science, viz. "the United of the Universe" or as Kepler calls it "the Harmony of the World", and according to Einstein "the Theory of f United Field", where separate forms of the movement of matter, which are different in quality, are always subjected to the regularity of oscillatory movements and at definite correlation pass into each other.

17. Perovskaia Street  
Tbilisi  
1961

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PART I

**ON THE FORCE OF UNIVERSAL GRAVITATION**



## CHAPTER I

### ON PLANETARY MOTION AND ATTRACTIVE FORCE OF THE SUN

#### § 1. CONDITIONALITY OF NEWTONIAN MECHANICS

The laws of motion of bodies are studied in the section of mathematical physics – theoretical mechanics, and all the relations between the basic concepts of mechanics are defined by the principles given by Newton as far back as 1686, in his famous work “The Mathematical Principles of Natural Philosophy”.

These principles, or axioms, are the basic laws of motion.

The first law – the law of inertia: Every object at rest or in a state of rectilinear uniform motion tends to remain in this state unless an external force is applied to it.

The second law – the fundamental law of dynamics: Force equals the product of mass and acceleration.

Third Law: For every action there is an equal and opposite reaction.

On the basis of these laws and guided by the Kepler’s laws Newton gave the fourth law – the law of universal gravitation:

$$F = -G \frac{Mm}{r^2}. \quad (1)$$

Two bodies attract each other with a force directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

These principles of motion in dynamics play the same role as axioms in geometry; in these laws, the doctrine of motion develops deductively, by means of formal logic, as a set of mathematical derivations and results.

All these conclusions are of speculative nature; they establish the laws of motion without referring to nature, and all conclusions based on these principles will be speculative.

“You should not apply your principles to the nature, you need to find dialectical laws in the nature and extract them from it” (see Engels, *Anti-Duhring*, p. 10).

«If a planet moves non-uniformly or curvilinearly, we say that it is under the action of the attractive force of the Sun which is directly proportional to the product of their masses and inversely proportional to the square of the distance between them. But is this force real? When Newton was given this question, he passed it in silence, and we also can say nothing about the reality of this force.

It should be noted and emphasized that the modern theory of gravitation does not belong entirely to Newton; this teaching is greatly exaggerated and reinterpreted by ardent followers of the great man, who in their expressions deemed unnecessary to stay in the bounds of his brilliant caution.

“To assume that gravity is inherent to matter, characteristic of it so that one body should act upon another at a distance through a void, without mediation of anything foreign, with the help of which the action and the force could be transferred from one body to another – this is for me such a nonsense that to my mind no person capable of philosophical thinking will fall into it”(from Newton’s works and letters).

As we see, Newton regarded the laws of gravity only as a point of comparison, proceeding from the formula for the acceleration of the celestial bodies to be inversely proportional to the square of the distance.

The great genius warned everybody not to understand the gravity in the literal meaning, since the idea of the natural tend of celestial bodies to their center was still stuck firmly in the minds of scientists of the XVII century.

M.V. Lomonosov rightly believed that “Newton in his lifetime did not recognize the attractive forces, and after his death, by efforts of his pupils, appeared to be their involuntary supporter.



And indeed, with the development of science of celestial mechanics based on the law of universal gravitation as on the fact that needs no explanation, the followers of his teaching forgot entirely about the purely descriptive character of this law and began to take it as a certain complete phenomenon representing a really physical manifestation of some force – pulling, drawing, attracting (see O. D. Khvolson. Course of Physics, vol.1, pp. 192-194), and with the help of this wonderful force, allegedly proved by Newton, Lagrange successfully pulled out the moon ball into a pear the thin end of which cannot be seen because it always faces the Sun, and never turns to the Earth, and Laplace easily, like a goose feather, raised the ocean waters on both sides of the globe, whereas other scientists, using this force, make the line of apsides rotate toward the increasing sector velocity regardless of the planets scattered in the Universe.

“If there is ever something trustworthy in the world, it is undoubtedly the fact that the particles of the bodies and the bodies themselves are not actually attracted, and that attraction is not a real force, but must be taken only as an explanatory power which facilitates the study of physical phenomena that occur in nature in such a way as that as if there is really an attraction, although there is nothing more undeniable than the contrary truth” (see A. Gano, Course of Physics, p. 35).

It must be emphasized that both the law of universal gravitation and other Newton’s laws, not only exhaust the development of physics as a science and technology, but are a certain system of world outlook of the XVII century. Therefore, it would be wrong to consider Newton’s works only in terms of internal connection with the economy and technology of the epoch. Recognition of the modality of motion, denial of moving matter, the doctrine of absolute space and time –these are the philosophical foundations given by Newton which for more than 300 years have been forming the basis for development of whole classical physics.

The doctrine of absolute space without any physical properties, of space and time as a category of thought, so strengthened in the views of the next generations, that after the works by the physicists of the XX century, who

rejected this abstract concept, many attempts have been made to save the Newtonian scheme of metaphysical materialism.

The doctrine of the structure of matter, the electromagnetic theory of light, the theory of relativity, wave mechanics, new quantum mechanics – these are the ways in which Newtonian mechanics as a science has undergone fundamental changes in its content.

There appeared new ideas, new laws, new principles, which compelled one to change the old laws, even though they were acceptable for practical purposes.

Therefore, it was necessary to synthesize new scientific advances with old concepts, to reveal their logic, namely the dialectical-materialistic basis so that they would follow from the “unity of the Universe.”

On this basis, it became necessary to give a physical meaning, i.e. to physically interpret the formulas for planetary motion which were given by Newton in the correct mathematical form in his immortal work “Mathematical Principles of Natural Philosophy”.

Since the criterion of practice is the basis and meaning of all true philosophy and science, it is necessary, to reveal in practically correct mathematical equations for motion of celestial bodies their physical nature so that they could reflect common basic laws both for planetary and terrestrial mechanics and for the interior of the atom and in general for the nature as a whole, whereas in classical physics, the laws of dynamics have nothing to do with the force of universal gravitation (see Khaikin, *Mechanics*, p. 268).

It should be noted that Newtonian mechanics and his philosophical system is not something inviolable, on the contrary, all this is conditional. It is possible and necessary to construct other mechanics that would rely entirely on another philosophical system – on dialectical materialism.

“The fact that the system of mechanics is based on a few basic principles, points to the possibility that someday the Newtonian system itself, or the Newtonian system modified by the principle of relativity, even if it is not taken as incorrect, will be replaced by a simpler one, even in elementary books “(F.R. Multon,” *Introduction to Celestial Mechanics*, p. 22).

Hence, we can conclude that the speculative laws of Newtonian mechanics cannot be regarded as absolute truth, they have no logical contradictions on the Earth surface, since our observations and setups are not perfect, but it is impossible to confirm these principles by direct experiments, because in carrying out terrestrial experiments and observations we cannot realize the required conditions to verify the basic laws of motion.

## **§2. GRAVITY IN NEWTONIAN MECHANICS AS A CAUSE OF MOTION OF BODIES**

Studying the laws of motion of celestial bodies, we must remember that the idea of the revolution of planets around the Sun and around their axis, as well as the idea that each star – the Sun – the center of a separate planetary world – has been known for a long time, since the foundation of astronomy.

Similarly, the idea of attraction of planets and quadratic decrease of gravity developed by Newton, was known in ancient times, and is preserved in the teachings of the Greek philosophers of the Pythagorean schools, whose sole purpose was to establish systems of the world and to study the motion of celestial bodies on the basis of philosophical speculations.

Together with the study of the sound, the motion of the Earth and standing “of the Sun – Apollo”, which, apparently, was one of the most important mysteries of the miracle-plays “Thebes” and “Memphis”, Pythagoras, under obligations taken on oath, brought from Egypt the idea of “gravitation”, not as a pulling – attracting force, but as an irresistible – natural tend (impetum) of the bodies towards their center.

The doctrine of the Pythagorean schools with its philosophical speculations on the structure of the Universe passed, among other works, from the Greeks to the victorious Arabs under the peace treaty.

The outstanding Arab mathematician and astronomer of the eighth century Thabit-ben-Qurra is known for his famous theory of forward and

backward motion of the “fixed” stars, or, as he puts it, of the approach and separation of the “fixed” stars to and from their center.

This doctrine was followed by the Arab astronomer, the truly Ptolemy of the Arabs, al-Battani, and both of them were given credit for knowing the causes of motion of celestial bodies, the proof of which they saw in the shift of the apogee first discovered by al-Battani (Suter, History of Mathematical Sciences).

These learned people of the ancient world, in their philosophical arguments, were not keen on mathematical formulas, they gained deeper insight into the mysteries of nature and happily guessed that “gravity – motion” is one and the same manifestation of some natural physical phenomenon of nature.

This shows that not all the achievements of the recent science are indubitable, as we imagine, that obviously in nature, there are other simple ways to reach the truths that Newton taught us to find through the law of gravity and the related and often impossible calculi.

Recent astronomy assures us that the body moves because it is heavy, but still with higher probability it can be stated that the body is heavy because it moves.

We have Kepler’s three laws for the motion of celestial bodies – planets. Since these laws are based on the long-term observations of natural phenomena occurring in reality, they are basically real and in no case must contradict the fundamental law of celestial mechanics for the motion of planets – gravity.

Since this law of celestial mechanics is neither experimentally proved nor disproved on the earth’s surface, let us apply it to the celestial bodies and establish, how far the real Kepler’ laws for planetary motion are consistent with the given Newtonian principles for the planetary motion.

It should be borne in mind that “in classical physics the laws of dynamics are in no way connected with the existence of gravity. In terms of classical physics the laws of dynamics could exist and preserve their meaning and form, even if there were no gravity forces at all (see S.E.Khaikin, Mechanics, p. 268).

The planetary motion in celestial mechanics is considered as inertial motion and attraction to the fixed centre by a force inversely proportional to the square of the distance (formula 1), and this allegedly establishes the connection between Kepler's and Newton's laws. The motion of each planet around the Sun due to the principle of inertia and forces of gravity is reduced to this problem.

“Forces by which main planets constantly deviate from the rectilinear motion and are retained in their orbits, are directed towards the Sun and are inversely proportional to the square of the distance to its center” (I. Newton, *Mathematical Principles of Natural Philosophy*).

Consequently, “the basic idea of the Newtonian fundamentals consists precisely in representation of the motion of the Moon and planets as a consequence of the geometric addition of two forces: 1) force of inertia (the initial impulse) and 2) force of gravity directed to the attractive center” (Baev, L'vov, Popov, *Astronomy*, p. 89; Engels, *Dialectics of Nature*, p. 167; B. M. Hessen, *Socio-Economic Roots of Newton's mechanics*, p. 40).

Hence, according to Newton, to obtain the planetary orbit, i.e. the Keplerian ellipse, we have the following conditions:

1. The Sun attracts the planet with some force (form. 1) and imparts it acceleration inversely proportional to the square of the distance.
2. On the basis of the law of inertia, the planet has a rectilinear uniform motion with acceleration, equal to zero.
3. Both motions caused by attraction to the Sun and inertia during the motion lie in the same plane.

By adding these motions we obtain the planetary orbit as the trajectory, i.e. a Keplerian ellipse with all its properties.

This physical interpretation of the elliptic shape of the planetary orbit, according to Newtonian mechanics, is contrary to the mathematical derivations of the elliptical shape of the planetary orbit given by Newton.

To clarify the above conclusion, let us discuss the existing methods for proving universal gravitation, and show that all this is false, wrong, unacceptable from the scientific standpoint, contradicts the existing laws

of theoretical mechanics, the mathematical formulas given by Newton for planetary motion and the general essence of the natural physical phenomena, as well as the whole system of dialectical-materialist worldview.

Along with this rigorous mathematical analysis we will try to reveal the physical essence of the elliptical shape of planetary orbits, and using mathematical derivations, prove that real – valid Kepler’s laws and their results – differential equations of motion of planets of the solar system, practically correct, proved by experiments and observations of the phenomena of celestial mechanics, are not gravity and inertia, as stated by astronomers and physicists, but represent true dialectical laws of nature – attraction–repulsion, i.e. oscillatory motion, “and these processes are considered by us here not as so-called forces, but rather as simple forms of motion” (Engels, *Dialectics of Nature*, p. 165).

### **§3. DYNAMIC AND KINEMATIC PROOF OF PLANETARY MOTION UNDER GRAVITY AND INERTIAL FORCES**

**The first proof** – dynamic demonstration.

These experiments were carried out at Berlin Observatory. A rod-shaped electromagnet pole turned into a hemisphere was placed under a glass plate. Then, a small steel ball, smeared with ink, was forced to roll along the plate with a certain initial velocity in a certain direction.

The ball made marks which, depending on the initial velocity and magnetic field strength, seemed curved but had nothing to do with Kepler’s laws. Curves always were spirals of irregular shape, twisted around the center, and finally the ball stopped over the magnet (see B. Meyer, *Glaserapp, the Universe*, p. 599).

Only one phenomenon attracted attention of researchers: if a weaker magnet was placed on the plate so that the ball could pass close to one of its poles, the curves changed their form and as if shifted gradually.

This phenomenon formed the basis for the theory of planetary perturbations and apsidal motion.

Thus we see that only forcedly assuring ourselves, we get the desired result, otherwise it is a complete failure of numerous attempts in this direction.

“The Keplerian ellipse is not amenable to dynamic demonstration at all” (Paul, Mechanics, p. 51).

**The second proof** – kinematic demonstration.

Kinematic construction of the trajectory by addition of two or more motions is performed with all mathematical rigor both graphically and by calculation, even for such complex curves as Lissajous figures.

But the kinematic construction of the Keplerian ellipse on the principle of universal gravitation and inertia cannot be performed either graphically or by calculation.

In fact, let a certain central body (see Fig. 1), for example, the Sun (S) with the force  $F$  attracts the planet moving by inertia and imparts it acceleration inversely proportional to the square of the distance between them;

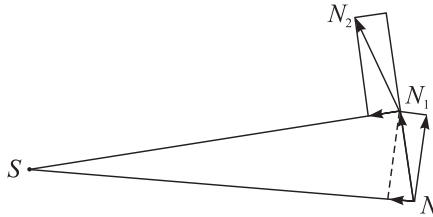


Fig. 1

in compliance with this physical interpretation of the force of universal gravitation [§2] which was preserved to the present day, according to Newtonian mechanics, it is “a free motion of bodies in the gravitational field”.

In the courses of analytical and celestial mechanics, explicit differential equations for such kinds of motion are given:

$$\frac{d^2x}{dt^2} = -m^2 \frac{1}{x^2} \quad \text{and} \quad \frac{d^2y}{dt^2} = 0 \quad (1a)$$

(see Buchholz, Mechanics, page 287; E. Grimsel, Course of Physics, vol. I, p 45; Multon, Introduction to Celestial Mechanics, pp.50 and 64; K.Shefer, Theoretical Physics, vol.1, p.50).

From these differential equations (1a) which, according to the physical interpretation of the force of universal gravitation (form. 1), reflect exactly the attraction to the center and inertial motion, it is impossible to obtain the Keplerian motion, and hence, they are contrary to all the experimental data of celestial mechanics.

These “geometric reasoning” – as noted by Multon, have nothing in common, contain many, often unpleasant difficulties “(F.R. Multon, Introduction to Celestial Mechanics, p. 74).

This is evidenced by F.Engels in “Dialectics of Nature” (page 167):

“Due to this fact, it (astronomy) introduces to the theory an element of motion that, as we have seen, inevitably leads to the idea of creation and destruction of motion, and therefore also implies a creator”.

“Inexplicable is the fact that in the middle between aphelion and perihelion no state of equilibrium is attained; it is distorted toward aphelion by gradual curvature of the trajectory, while for the kinematic construction and the dynamic action of the force, according to the law of gravity of the body from the center, in other words, at the moment of the greatest preponderance of one force over another a sudden turn toward aphelion takes place. Similarly, at the time of standing of the planet close to aphelion (according to Newtonian mechanics), there definitely dominates the centrifugal force, and it is not clear why in the aphelion a weaker centripetal force predominates and rotates the planet. It is evident that here some other force must interfere, which could cause this rotation” (Hegel, Logic, vol. V, p. 447).

This philosophical conclusion of Hegel that the central force cannot give a closed orbit without the intervention of some other force, found a mathematical proof in mechanics in the section of central forces.

«This equation shows that for central forces the relative motion of a point along the radius-vector takes place “as if” under the action of two



forces –  $F$  and a certain additional force  $m^2 \frac{c^2}{r^3}$ ” (see Buhholz, Mechanics, vol. 1, p.293). This additional force  $\frac{c^2}{r^3} = mr\varphi'^2$  is a normal component of translation acceleration and is obtained from the repulsive motion.

This confirms the opinion existing in science that the Keplerian ellipse in Newtonian mechanics is not amenable to kinematic construction.

“The Keplerian ellipse is kinematically poorly amenable to demonstration, and dynamically – is not amenable at all. This situation justifies fully a complete failure of numerous attempts in this direction“ (see R. Paul, Mechanics, p. 51).

This phenomenon was indicated earlier by Descartes, Huygens, Leibniz, Kant, Hegel, D. Bernoulli, Engels and others.

Huygens wrote to Leibniz that “he is rather displeased by many explanations and theories of the latter (Newton), that the principle of gravitation seems absurd to him, that he had already proved it”.

«In the XVIII century M.V. Lomonosov and Euler, paying tribute to Newton, sharply criticized his conception of the doctrine of gravitation (see. M.V. Lomonosov, Complete Works, vol. II).

“The whole doctrine of gravity is reduced to an assertion that gravitation is allegedly the essence of matter. This is necessarily false“ (see Engels, Dialectics of Nature, p. 144).

Actually, the differential equations for planetary motion from which the Keplerian motion can be obtained and which are practically confirmed by observations of motion of celestial bodies are given as

$$\frac{d^2x}{dt^2} = -m^2 \frac{1}{r^2} \cos\varphi \quad \text{and} \quad \frac{d^2y}{dt^2} = -m^2 \frac{1}{r^2} \sin\varphi \quad (2)$$

or

$$x'' + \frac{m^2}{r^3} x = 0 \quad \text{and} \quad y'' + \frac{m^2}{r^3} y = 0 \quad (2a)$$

These differential equations in celestial and theoretical mechanics are known as “central motions”, and to obtain a closed curve, i.e. the Keplerian

ellipse, besides the attractive force, a certain additional force is required (see Buhholz, Theoretical Mechanics, p.293).

This additional force  $m\frac{c^2}{r^3}=mr\varphi'^2$  which is a normal component of translation acceleration (see §5) is obtained from the repulsive force. i.e. this additional force is also of central character.

Hence, differential equation (2), besides the central attractive force, also includes the repulsive force which is also of central character.

It becomes obvious if we represent differential equations (2) as

$$\frac{d^2x}{dt^2}=-m^2\frac{\cos^3\varphi}{x^2} \quad \text{and} \quad \frac{d^2y}{dt^2}=-m^2\frac{\sin^3\varphi}{y^2}.$$

If the first differential equation

$$\frac{d^2x}{dt^2}=-m^2\frac{\cos^3\varphi}{x^2},$$

expressing the acceleration for the motion along the  $x$  axis and obtained from the equation  $x=r\cos\varphi$ , is an attraction to the center, the other differential equation

$$\frac{d^2y}{dt^2}=-m^2\frac{\sin^3\varphi}{y^2},$$

expressing the acceleration for the motion along the  $y$  axis and obtained from the equation  $x=r\cos\varphi$ , is opposite to attraction, i.e. repulsion from the center.

With the change of  $\varphi$ -true anomaly their mutual opposition is always preserved being a unified form of motion.

The idea of the unity of mutually opposite forms of motion is the main and fundamental dialectical law of nature.

Engels writes in "Dialectics of Nature" (p. 144 and 165): "...Hegel quite correctly noted that the essence of matter is attraction and repulsion ... Kant had already considered matter as the unity of attraction and repulsion ... The basic form of motion of matter is approach-separation, contraction-expansion, attraction-repulsion...".

#### §4. DIFFERENTIAL EQUATIONS OF PLANETARY MOTION

The third proof – analytical derivation.

The mathematical proof of the force of universal gravitation is supposedly based on real Kepler's laws and, as noted above, this basic principle (attraction) in no case must be contrary to the actual Kepler's laws – the laws of planetary motion.

As is known from celestial and analytical mechanics, differential equations for planetary motion are given in the form

$$\frac{d^2x}{dt^2} = -\mu^2 \frac{1}{r^2} \cos\varphi \quad \text{and} \quad \frac{d^2y}{dt^2} = -\mu^2 \frac{1}{r^2} \sin\varphi,$$

which are the planet acceleration inversely proportional to the square of the distance.

Here,  $r$  is the radius-vector,  $\varphi$  is the true anomaly – the angle between the radius-vector and the  $x$  axis, and  $\mu^2$  is a certain constant.

If we *a priori* assume for celestial bodies on the basis of Newton law

$$f = ma$$

that the acceleration (formula 2) is caused solely by the attractive force of the Sun (see Buhholz, Mechanics, vol.1, p.293)

$$F = -\gamma^2 \frac{Mm}{r^2}$$

always directed to the Sun, we set the initial conditions  $\cos\varphi = \frac{x}{r}$  and  $\sin\varphi = \frac{y}{r}$  – the constants, in other words, the integration constants must be such that the initial velocity is either equal to zero, or directed along the radius-vector.

Integrating equations (2) under these assumptions, when differential equations (2) represent the acceleration caused by attractive forces of the central body, we obtain the trajectory of the body as a straight line.

Then equation (1) can be reduced to the general form

$$\frac{d^2s}{dt^2} = -\mu^2 \frac{1}{s^2},$$

the integration of which is given in the courses of celestial and theoretical mechanics and shows that attractive forces inversely proportional to

the square of the distance give the trajectory in the form of a straight line, and with the initial velocity smaller than  $\sqrt{\frac{2m^2}{s_0}}$ , the velocity of the body at the finite distance from the center becomes zero; the body in this point stops and begins to move back to the center.

But if the initial velocity of the body is equal or higher than  $\sqrt{\frac{2m^2}{s_0}}$ , we obtain respectively asymptotic or progressive motion (see F.P. Multon, Introduction to Celestial Mechanics, p. 59).

If we set the integration constants, i.e. initial conditions such that the initial velocity is not equal to zero and is directed at an angle to the radius-vector, this will be similar to the assumption that in differential equations (2) for planetary motion

$$\cos\varphi = \frac{x}{r} \quad \text{and} \quad \sin\varphi = \frac{y}{r}$$

are the constants.

Under this assumption, we have two motions: one directed along the radius vector, and the other – at an angle to it. This conclusion is given in Buchholz mechanics (volume I, p. 294), where the velocity is represented as a sum of the radial and transverse velocities.

Based on analytical mechanics, we can say that differential equations (2) of planetary motion represent a resultant force of three accelerations (see E.L. Nicolai, Lectures on Theoretical Mechanics, vol. I, p. 177, 183), i.e. the absolute acceleration equal to the vector sum of three accelerations: translation (transverse), relative (radial) and Coriolis acceleration.

The translation acceleration, transport velocity and the trajectory of translational motion will be referred to as the acceleration, velocity and trajectory of the point of the solid body (the medium), which at this moment coincides with the moving point (see G.K. Suslov, Fundamentals of Analytical Mechanics, vol. I, p. 141, E.L. Nikolai, Lectures on Theoretical Mechanics, vol. I, p. 166).

Consequently, by the first integration of differential equations (2) we obtain the absolute velocity, which is equal to the sum of transport and relative velocities, and by the second integration – absolute motion, i.e. the

trajectory which is composed of the translation (transverse) and the relative trajectories of the motion of the body.

If the laws of motion of celestial bodies – gravitation and inertia, given by Newton are correct and real, the obtained translational and relative motions must satisfy these conditions, i.e. reflect the motion caused by the attractive force of the Sun with acceleration inversely proportional to the square of the distance, and the inertial motion – the rectilinear and the uniform motions with acceleration equal to zero (see Popov and Baev, Astronomy, page 150 and 151).

According to Newton, both the translational and the relative motions must be rectilinear in the same plane.

Analytical mechanics easily solves this problem: let us find separately the translational and the relative motions of the planet, for which purpose first analyze differential equation (2), where it can be shown that the double sector velocity “ $2k$ ” is constant and equal to:

$$2k = r^2 \varphi'. \quad (3)$$

After double integration we have

$$\left. \begin{aligned} \frac{d^2x}{dt^2} &= -m^2 \frac{1}{r^2} \cos\varphi, & \frac{d^2y}{dt^2} &= -m^2 \frac{1}{r^2} \sin\varphi, \\ \frac{dx}{dt} &= -\lambda \sin\varphi, & \frac{dy}{dt} &= \lambda \cos\varphi + c, \\ x &= r \cos\varphi, & y &= r \sin\varphi, \end{aligned} \right\} \quad (4)$$

where  $c$  is the integration constant,  $\lambda$  is a certain constant.

Expressing these equations in angular velocities of the mean anomaly  $nt$ , we obtain

$$\left. \begin{aligned} \frac{d^2x}{dt^2} &= -n^2 x \frac{1}{(1-\cos E)^3}, & \frac{d^2y}{dt^2} &= -n^2 y \frac{1}{(1-\cos E)^3} \\ \frac{dx}{dt} &= -ny \frac{1}{(1-e \cos E) \cos \beta}, & \frac{dy}{dt} &= +nx \frac{1}{(1-e \cos E) \cos \beta} + C \\ x &= a \cos E - f, & y &= a \sin E \cos \beta, \end{aligned} \right\} \quad (4a)$$

where  $n$  – is the daily mean motion.

As we can see, these correct equations adequately reflecting the Keplerian ellipse, justified by experiments and observations of the motion of

celestial bodies, in no way express the physical interpretation of the elliptical shape of the planetary orbit, which is given by Newtonian mechanics.

Since mathematical thinking, like any scientific thinking, is a reflection of objective reality, and equations (4) and (4a) justified by the experimental observations of the motion of celestial bodies are in mathematical terms an expression of the objectively existing forms of motion, we have to find these motions.

On the other hand, we know the theorem proved by the great French mathematician Fourier: “Any periodic function can be expanded into harmonic functions”, i.e. in series, made up of cosines and sines.<sup>1</sup>

On the basis of this theorem, the theory of oscillatory motion proves that every periodic motion is an oscillatory motion<sup>2</sup> (the contrary conclusion is not true: not every oscillatory motion can be periodic).

We are well aware that the motion of planets and comets of the solar system is a periodic motion, so we may say that equations (4) representing precisely the periodic motion of planets and comets of the solar system should have clearly expressed characteristics of the laws of oscillatory motion, which is actually confirmed.

Consequently, the opinion existing in science that it is impossible to obtain the Keplerian motion from oscillatory motions (the essence of Bertrand’s problem) is an unconfirmed conclusion which contradicts the Fourier theorem. This naked assertion is unconvincing and unacceptable.

Proceeding from the above, we can formulate the problem mathematically:

“To find such oscillatory motions which as a result of addition will give the Keplerian motion with all the observed phenomena.”

This problem, according to Fourier theorem and D. Bernoulli<sup>3</sup> principle, is solvable, and we must solve it. This must be done because the metaphysi-

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<sup>1</sup> A. A. Eikhenwald, *Theoretical Physics*, part II, p.123.

<sup>2</sup> S. Ritov, *Teaching of Oscillations and Waves*, p. 4.

<sup>3</sup> See “*Histoire de l’academie de Berlin*”, 1753 – «In each system, mutual movements of bodies are always a combination of various simple, regular and conserved oscillations”.

cal picture of Newton's world, standing alone among such diverse natural phenomena and leading to the creator, as well as the artificially curved picture of Einstein's world, leading to the closed Universe, cannot satisfy us; it must be replaced by the dialectical-materialistic view of the world, leading to the "unity of the Universe".

As noted by Einstein, "the idea that there are two independent space structures – metrically-gravitational and electromagnetic is intolerable for a scientifically thinking mind."

For this purpose let us examine equations (4) and (4a).

It should be borne in mind that any kind of motion is always governed by the law of path variation (shift), velocity and acceleration. In all cases, these essential features by which a form of motion can be established are always selected in the same way (see. P. Znamensky, E.N. Kelsen, I.A. Chelyustkin, *Methods of Teaching Physics*, pp. 209-210).

Such an approach to determine the type of motion is also valuable in that it is based on the physical aspects of the phenomenon so that the mathematical relationships for the path (shift), velocity and acceleration are the consequence of a fundamental physical law. In addition, the study of the processes from this standpoint develops the ability to analyze various phenomena by means of comparison, which is extremely useful in the study of new unexplored processes often found in nature (Acad. Papalexi).

For physical interpretation of differential equations of motion, the law relating path variation, velocity and acceleration is more important than a simple equality of separate equations; then it is easy to see that these equations, different at least in form, belong to certain general classes or types.

This rigid mathematical similarity of the above indicators of motion is sufficient to express a far-reaching relationship of physical regularities.

Drawing up a table for the path, velocity and acceleration variation in all quarters of a moving object around the fixed center, according to equations (4) and (4a), and determining the direction and change in the components of the path, velocity and acceleration vectors, according to the rules accepted in mechanics, we get

1. Acceleration increases (or decreases) with increasing (or decreasing) shift in the direction opposite to it.<sup>1</sup>

“The components of acceleration are proportional to the coordinates” (see Multon, *Celestial Mechanics*, p. 75).

2. The acceleration is always directed to the center of motion, in this case, to the origin, i.e. to the focus.

3. With increasing velocity the acceleration decreases, and vice versa.

Here, the acceleration components are proportional to the shift and opposite to it, and with increasing velocity the acceleration decreases, and vice versa – these are main characteristic features of oscillatory motions unlike the motions caused by attractive forces where the velocity and acceleration simultaneously increase or decrease (see A. Eichenwald, *Theoretical Physics*, Part II, p. 90; N.N.Andreev, G.S. Gorelik, *Physics*, vol. I, p. 259, and others).

Thus, considering differential equations (4) for planetary motion, we come to the following inevitable conclusions:

1. The trajectory of the absolute planetary motion, i.e. the Keplerian ellipse, consists of two motions: translational and relative.

2. The components of the absolute planetary motion in the coordinate axes are the motion of oscillatory nature.

These correct mathematical derivations indicate that both the translational and the relative motions – are of oscillating nature.

By making this correction-supplement, as a result of the physical interpretation of mathematically true, almost correct formulas (2) given by Kepler-Newton for the motion of celestial bodies, we come to proper understanding both of mathematical formulas (2-4) and the dialectical laws of nature. Without this correction, Newton, to construct the Keplerian ellipse, had to impart matter, besides attractive, some tangential force of central

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<sup>1</sup> The increase in  $\frac{d^2y}{dt^2} = -m^2 \frac{\sin^3\varphi}{r^2}$  with increasing shift  $y=r\sin\varphi$  depends on eccentricity and occurs up to 86° for planets and up to 68° for comets with the change of  $\varphi$  (inflection).



character, carrying the planet in the direction perpendicular to this attraction. But, as shown by mathematical formulas (4) and the dialectical laws, this is by perforce false and wrong.

If we, with correct interpretation of the laws of dialectical thinking, reduce this tangential force to a certain form of motion of central character, i.e. repulsion, then, in full accord with mathematical formulas (4, 4a) and dialectical laws of nature, we can perform kinematical and analytical construction of the Keplerian ellipse with all its characteristic properties without the first “divine impulse”.

It should be noted and emphasized here that the modern Newton’s idea of gravitation, comprehensively defined and brought to perfection was formed under the influence of vague ideas of former times and the ancient world. The idea of the retention of celestial bodies around the center involves “something” so common and natural that we, even in the most ancient ideas and speculations of scholars of the ancient world, find it as the overwhelming tend (impetum) of bodies towards their center.

As far back as the beginning of the V century BC, Empedocles of Agrigentum in Sicily wrote various essays on some topics of physics, from which Aristotle cites the mysterious theories about attraction and repulsion of celestial bodies. According to Empedocles, it is a teaching about friendship and discord of celestial bodies and of elements in general, which as it gives us an idea of gravity and centrifugal force; therefore, Empedocles was thought to know the causes of motion of celestial bodies (see Suter, *History of Mathematics*, p. 37).

According to the teachings of the Chaldeans, the Sun is a glowing ball, it has a property to attract and repulse other celestial bodies.

In general, the ancient astronomers and the Pythagoreans believed that the Sun attracts and at the same time repulses celestial bodies being at harmonic distances, which thereby results in a smooth harmonic “procession” of celestial bodies (see V. Nozadze, *The Knight in the Panther’s Skin and the Role of the Sun*, pp. 47, 54, 91, 92; E. Palhories, *Vie et doctrines des grands pilosophes Antique*, Suter, *History of mathematics*, p. 34).

This idea of the Universe was contrary to the religious prejudices of the ancients, so the ancient philosophers expressed their ideas in allegorical form, in order not to be exiled from their homeland (Empedocles, Pythagoras, Aristotle, Aristrachus of Samos, etc.).

Shota Rustaveli, the great Georgian poet, the disciple of the Pythagorean school, in his immortal poem “The knight in the Panther’s Skin” glorifies in all its beauty the heliocentric system of the world and the interaction between the planets and the Sun in allegorical form, peculiar to the genius of the twelfth century, as ‘mijnuroba’ (love), i.e. an overwhelming desire of approach and separation from the beloved (see V. Beliashvili, Shota Rustaveli and Dante’s Mystery).

The founder of modern astronomy, the great Copernicus, believed that gravity is nothing else but a natural tend (*appetentia*) to its center. In his work “Astronomia instavrata” (Book. I, chapter 9), he writes: “I believe that gravity is “nothing else but a form of a natural tend inherent in the particles to combine in a single whole of spherical shape”.

Even the great Johannes Kepler, adequately named “the legislator of heavens”, tried to explain the reason for the revolution of planets around the Sun not only by their tend to the center, but also assumed a certain magnetic repulsion (see *Astronomia nova seu de mota stellae Martis introductio*, p. 300; see E. Dühring, Critical History of General Principles of Mechanics).

Long before Newton, his contemporary Borelli, studying the movement of Jupiter’s satellites, proceeded from the idea that the planets and their satellites tend to approach the center around which they rotate, and that their circular motion at the same time causes the tend (*impetum*) to separate from the center.

Borelli considered the balance between the two impetums – approach and separation, as a cause of possible revolution (see *Teoricarum medicorum physisis deductae ex causis*).

Soon Huygens in his works introduced the notion of centripetal force, and Kepler in his works had already established the fact of quadratic decrease in attraction about which Newton wrote to Halley on 14 July 1688 (Brewster, *Memoirs of the life of Newton*, p. 449). Furthermore, Newton

himself admitted that this law was independently discovered by Hooke, Wren and Halley (a footnote to proposition IV, corollary 6, book I).

After these conclusions and the above disparate ancient ideas of the tendency of bodies to approach and separate from the center, Newton had only to replace the motion by gravity and to obtain his result -"force of gravity", and, paying tribute to the epoch, he replaced a healthy dialectic grain – the idea of repulsion by the "first divine impulse".

But initially he kept himself from the notion of "force" of gravity as an attractive force, so as not to be harassed, and attaching this view no value, founded the doctrine of gravitation regardless of the idea of internal property of the force.

Of course, the foregoing does not mean that the ancient idea of motion of planets of the solar system in any form provided a certain complete view or some principal tenets; only in terms of modern concepts these disparate vague ideas seem more defined than when they could be conceivable. But it does not mean that the ideas of ancient scientists, in particular the ideas about the dual tend of the body –to approach and separate from its center, could be unmotivated and irrational, as many people are inclined to believe. These ancient ideas had their reasons – psychological and objective, and therefore, they were consistent, to some extent, with the phenomena and theoretical-cognitive aspirations of the ancient world. It would therefore be a great mistake if we abandoned the idea to compare the opinions of philosophers with our new knowledge in relevant fields and to consider them in the light of new achievements, new discoveries of modern science.

Can you neglect the teaching of Democritus of Abdera and his predecessor Leucippus about the atomic theory, which in ancient times was not developed but opposed to the Platonic spiritualism the materialism, which, if not in antiquity, but now has occupied a foreground in science and philosophy and formed the basis for Democritus to found the system of the world, which was outlined by Lucretius in his work "*De rerum Natura*".

Was not it Democritus who taught that all bodies fall with the same velocity in empty space, that solid bodies have pores, and that light comes

from the emission of small particles from a luminous body (see Suter, History of Mathematical Sciences).

Was not it Pythagoras who explained the phenomenon of sound, light and heat by “internal vibrations” (a doctrine borrowed from the Egyptian mysteries in the description of the Memnon statue).

And all of them are teachings, which partly even today are recognized as true, but by the irony of fate are attributed to other authors. But Democritus was still the first among all the philosophers of the past and of our century who formed a clear idea about physical essence of natural phenomena and took as a basis the system – materialism used even now by the greatest scientists to build their brilliant teachings and discoveries.

Of course, it is also true that the physical concepts of Democritus are wrong and erroneous, but the philosophical basis of Democritus – his philosophical doctrine is a correct materialistic direction.

Likewise, a dual *impetum* of celestial bodies to their center, according to the notions of the ancients, was nothing definite, logical, complete, but the philosophical basis of this teaching – the simultaneous tend of the celestial bodies to approach their center and to move away from it without any cause, i.e. without any force, becomes more understandable and acceptable in our epoch with the development of ideas of mutually opposite forms of motion, i.e. dialectical-materialist teaching.

The above idea is a spontaneously correct, purely dialectical-materialistic direction developed scientifically in our epoch by Marx and Engels: “The basic form of any motion is approach – separation, attraction – repulsion,” etc. (see Engels, Dialectics of Nature, p. 165).

In modern mechanics, attraction – repulsion, approach – separation – is an oscillatory motion.

Engels in “Dialectics of Nature” (p. 143) notes: “based on dialectics it can be predicted that the true theory of matter must assign to repulsion the same importance as to gravity; that the theory of matter based only on attraction is false, insufficient and halved”.

Hegel quite reasonably pointed out that the essence of matter is attraction and repulsion (see Hegel, *Essay*, part II, p. 63). Similarly, Kant regards matter as “the unity of attraction and repulsion”.

Marx noted that in our solar system, the ellipse is such a form of motion in which the contradiction of attraction and repulsion is simultaneously realized and destroyed, since it is impossible to separate a continuous fall of one heavenly body onto another from its continuous separation.

But the genius of Newton is that he was one of the pioneers who could replace vague ideas of former times and the ancient world about the natural tend of the celestial bodies towards their center, i.e. natural motion, by “gravity”, but at the same time he also pushed aside the healthy dialectic grain – “the idea of repulsion” and put forward the idea of “the primacy of force over matter”.

Newton was the son of his epoch when science was a humble servant of the Church and it was not allowed to explain the actual paths of the planets and the structure by natural phenomena without the presence of the “rational divine principle”.

On the other hand, science had no coherent system of mechanics yet, and, in particular, no regularities of oscillatory motions were studied. Therefore, it was difficult for Newton to stop on the idea of mutually opposite forms of motion – attraction and repulsion, i.e., oscillatory motions, without the intervention or (as he writes to Bentley) “without recognition of the divine Creator of the Universe.”

But one must be a genius, like Newton, to put forward in that epoch at least one rational grain – the “idea of attraction”, although he conceded the other, its dialectically inseparable part “repulsion” to “the Creator of the Universe” as the first “divine impulse”, “forbidding him from further interference” (Engels, *Dialectics of Nature*).

Thus, “the idea of repulsion” was replaced by Newton by “the first impulse” – a “force”, but this idea was not raised and resolved in correct natural understanding not because his genius was not strong enough, but because the philosophical prejudice prevented Newton from the correct interpretation of facts, despite his bold thinking and fine intuition. Great

people solve only those problems that are posed by the historical development of their epoch.

The great genius reflected correctly the motion of the planets of the solar system in mathematical equations (2), but under the pressure of his epoch he gave these equations wrong metaphysical interpretation in the form of the attractive force, whereas these equations (2) represent the correct dialectical-materialist direction – “attraction – repulsion”.

And when, based on Newton’s works, the science at its turning point of development spontaneously went in a dialectical-materialist direction in correct mathematical equations, it immediately took a new road of progress, which ended with a powerful development of physics, astronomy and technology.

## **§5. DETERMINATION OF TRANSLATIONAL AND RELATIVE MOTION OF PLANETS**

After the above preliminary analysis of differential equations (2) let us discuss translational and relative motion of planets, i.e. determine the laws of planetary motion, or alternatively, what motions are involved in the orbit of the planet – the Keplerian ellipse, and then elucidate a question – what is a physical reason for the elliptical shape of orbits?

In the courses of celestial and analytical mechanics this question is formulated as follows:

“A body describes a conic section – an ellipse with a constant sector velocity around the focus of this ellipse; one should determine the magnitude and the direction of the velocity, acceleration” (and mostly the character of the motion) (see Suslov, Mechanics, vol. I, p. 84).

The Keplerian ellipse can be represented by three equations, depending on the choice of the coordinate system:

$$\begin{aligned} (A) x &= a \cos E, y = b \sin E; & (B) x &= r \cos \varphi, y = r \sin \varphi; \\ (C) x &= R \cos \Theta, y = R \sin \Theta, \end{aligned}$$

where  $E$  is the eccentric anomaly,  $\varphi$  is the true anomaly,  $r$  is the radius-vector from the focus,  $R$  is the radius-vector from the geometrical center,  $\Theta$  is the angle between the radius-vector  $R$  and  $x$ -axis.

Since the form of the orbit and the location of its plane in space changes with time, these movements (A, B, C) which are the planar motion, do not express the changes taking place with time in the elements of the orbit itself.

It is known from celestial mechanics that the planetary orbit is defined by six elements, three of which will be considered here:  $a$  – semi-major-axis,  $e$  – eccentricity and  $i$  – inclination of the orbital plane from the Laplace plane. The semi-major axis is not generally subject to secular variation, the eccentricity  $e$  and the inclination  $i$ , according to the Stockwell's table, change constantly (see. Subbotin, Course of Celestial Mechanics, vol. II, p. 291).

This table given by Stockwell according to Lagrangian, Poisson, Laplace, Leverrier, and Stockwell laws indicates that the eccentricity, for example of the Earth's orbit, which is currently equal to 0.078, decreases and in 24000 years will become zero.

Hence, the Earth's orbit will gradually change from an ellipse to a circle (see Multon, Celestial Mechanics, p. 369, M. F. Subbotin, Course of Celestial Mechanics, vol. II, p. 342).

Then the Earth will rotate around a circle, and at the same time the elliptical plane will coincide with the Laplace plane. The same is true for the other planets, with the only difference that the period of the eccentricity and inclination variation will be shorter or longer than that of the Earth.

After a long period of time, the eccentricity of each planet will begin to increase, and, having reached its maximum, begins to decrease again, and so on. At the same time the plane of the orbit of the planet moves away from the Laplace plane and the inclination of these planes reaches its maximum (according to the tables).

To clarify the nature of the motion of the planet in this secular variation of the eccentricity and inclination of its orbit, it is necessary to pay attention to one important fact proved even by Lagrange, Laplace and confirmed by Poisson (as far back as the XIX century) that the length of the major axes

of the planetary orbits is not subject to secular perturbations, i.e. it does not or almost does not change (see Subbotin, *Celestial Mechanics*, vol. II, page 51); this very important fact indicates that the planet, describing a circle and coming out of the Laplace plane, moves non-helically upward the spiral, and again approaches it for one revolution period.

Consequently, moving in a circle, the planet at the same time fluctuates up and down from the Laplace plane forming one trajectory – the Keplerian ellipse, ascribed to a particular frame of reference as a special phenomenon of motion showing a very interesting deviation ability that can manifest itself in our spatial representations.

In the study of these processes, we do not notice many diverse phenomena of motion therein, and therefore have to establish the regularity of path, velocity and acceleration variation, and then we will immediately see that the whole existing process itself is nothing else but the sum of various kinds of simple, regular and persistent oscillations.

Hence, it is clear that in the theoretical studies, the form of the orbit and the position of its plane in space must be determined from the Laplace invariable plane (see G. Duboshin, *Introduction to Celestial Mechanics*, p. 255), which has a relatively stable and unchanging direction in the solar system, and the laws of planetary motion must be expressed not by two coordinates  $x$  and  $y$ , but by three coordinates –  $x$ ,  $y$ ,  $z$ ; therefore, one should pass from these movements (A, B, C) defining the plane motion to the spatial motion.

According to the above (see also p.28), let us find the planet velocity and acceleration.

The planet velocity, according to the equations (A, B, C) for the Keplerian ellipse

$$x = a \cos E, \quad y = b \sin E$$

$$x = r \cos \varphi, \quad y = r \sin \varphi,$$

$$x = R \cos \Theta, \quad y = R \sin \Theta,$$

$$\text{is equal to } v^2 = (Ea)^2 - (Ef \cos E)^2 = E^2 r_1 r_2, \quad (5)$$

in polar coordinates

$$v^2 = (r')^2 + (r\varphi')^2 = E^2 r_1 r_2,$$



$$v^2 = (R')^2 + (R\Theta')^2 = E^2 r_1 r_2.$$

The geometrical velocity can be represented as

$$\left. \begin{aligned} \vec{v} &= \vec{E'a} - E'f\cos\vec{E} \\ \vec{v} &= \vec{r}' + r'\vec{\varphi}' \\ \vec{v} &= \vec{R}' + \vec{R\Theta}' \end{aligned} \right\} \quad (5a)$$

Let us find the planet acceleration  $G$ . Taking the second derivatives, we obtain

$$\begin{aligned} G^2 = (x'')^2 + (y'')^2 + (z'')^2 = (E''A)^2 + (E'^2A)^2 - [(E''f\cos E)^2 + \\ + (E'^2f\sin E)^2 - 2E''E'^2f^2\sin E \cos E]. \end{aligned} \quad (6)$$

In polar coordinates

$$\begin{aligned} G^2 &= (r'' - r\varphi'^2)^2 + (r\varphi'' + 2r'\varphi')^2, \\ G^2 &= (R'' - R\Theta'^2)^2 + (R\Theta'' + 2R'\Theta')^2. \end{aligned}$$

The acceleration (6) can be geometrically represented as:

$$\left. \begin{aligned} \vec{G} &= \overrightarrow{r'' - r\varphi'^2} + \overrightarrow{r\varphi'' + 2r'\varphi'} \\ \vec{G} &= \overrightarrow{R'' - R\Theta'^2} + \overrightarrow{R\Theta'' + 2R'\Theta'} \\ \vec{G} &= \overrightarrow{E''a} - (\overrightarrow{E''f\cos E} + \overrightarrow{E'^2f\sin E} - \overrightarrow{2E''E'^2f\sin E}) - \vec{E}'^2a \end{aligned} \right\} \quad (6a)$$

The reduction of formulas (6) and (6a) based on formula (3) will give

$$G = -E'^2a. \quad (7)$$

Considering these equations, we can easily see that we are dealing with translational and relative motions, as could be expected; by addition of these motions the absolute motion, i.e. the Keplerian ellipse with all its properties is obtained.

In fact, equations (5) and (5a) give the absolute velocity value as a vector sum of the transport and relative velocities.

Similarly, equations (6) and (6a) give the absolute acceleration value as a vector sum of the three accelerations: translational, relative and Coriolis, the components of which are expressed in the corresponding coordinates (see E.L. Nicolai, Lectures on Theoretical Mechanics, vol. I, pp. 183-184; G.K. Suslov, Fundamentals of Analytical Mechanics, vol. I, pp. 141-143; N. Buchholz, Main Course of Theoretical Mechanics, p.294).

Thus, there is no doubt that the velocity of the planet is obtained by adding the transport and the relative velocities, and differential equations (2) for the motion representing the absolute acceleration of the planet (see formula 7) are a vector sum of the three accelerations: translational, relative and Coriolis.

With the trajectory, velocity and acceleration of the absolute motion, as well as the velocity and acceleration of the relative and translational motion, we can easily find the translational and relative motion, i.e. the law of planetary motion.

For this purpose, consider equations (5), (5a), (6), (6a). Giving each separate expression its physical meaning (taking into account the law of absolute, transport and relative velocities and acceleration, integrating them and making an appropriate construct, according to the Stockwell's table [see Subbotin, Celestial Mechanics, vol. II, p. 291]), we see that the translational and relative motions occur in two different planes intersecting at an angle (formula 5a).

Taking these derivations and selecting Laplace plane as the main coordinate plane of the translational motion, and taking the intersection of this plane with the plane of the ellipse ( $A$ ), i.e. with the plane of the absolute motion as the x-axis, we can write equations which, according to formulas (5a), (6a) and Fig. 2, are expressed by the law of the translational motion:

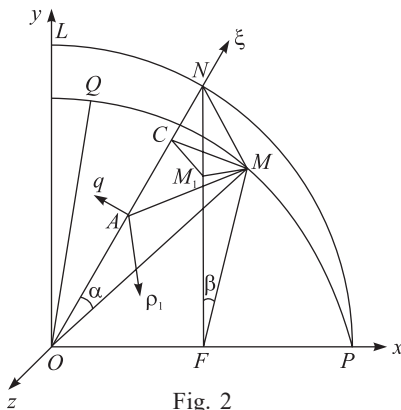


Fig. 2

$$\left. \begin{aligned} OF=x_A=a \cos E \\ NF=y_A=a \sin E \\ z_A=0 \end{aligned} \right\} \quad (8)$$

Thus, the translational motion occurs in the  $XOY$  plane and is a rotation of the planet around the  $x$ -axis.<sup>1</sup>

Since the velocity component of the relative motion is expressed as  $F'f\cos E$ , and its integral is  $f\sin E$ , we conclude from Fig.2 that

$$NM^2=ON^2-OM^2=a^2-R^2=f^2\sin E,$$

$$NM=f\sin E,$$

But, on the other hand, from the right-angled triangle  $NMO$  we have

$$NM=A\sin\alpha,$$

where

$$\alpha=\angle NOM,$$

Hence,

$$\sin\alpha=e\sin E,$$

These data suggest that the relative motion takes place in the  $ONM$  plane that is always perpendicular to the  $OPMQO$  plane of the absolute motion and forms a variable angle with the  $XOY$  plane.

The  $OPMQO$  plane is inclined to the  $XOY$  plane of the translational motion at constant angle  $\beta=QOL$ , therefore

$$OQ = OL \cos\beta, \text{ i.e. } b = a \cos\beta. \quad (9a)$$

Let us ascribe the relative motion to the system of coordinates  $A\xi\eta\zeta$  (Fig.2), then the equation for the relative motion law will be

$$AC=\xi=\frac{a}{2}\cos 2\alpha, \quad \eta=0, \quad CM=\zeta=\frac{a}{2}\sin 2\alpha, \quad (10)$$

Here the  $A\xi$  axis moving, lies in the  $XOY$  plane, while the  $A\zeta$  axis moving at the translational motion, always remains parallel to itself, i.e. perpendicular to the  $POQMP$  plane of the absolute motion.

In general, we get:

The planet revolving around the  $OZ$  axis in the plane  $XOY$ , i.e. in the Laplace plane (formula 8), at the same time performs pendulum-like oscil-

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<sup>1</sup> We regard the translational motion as a motion of the point of the sphere with which the planet coincides at this moment.

lations in the plane  $MON$  (formula 10), and in accordance with the laws of oscillatory motions the oscillation plane is retained, and the period of forced oscillations (in the first approximation) is equal to that of primary rotation.

Adding the translational (8) and the oscillatory motion (10), we obtain the Keplerian ellipse  $PQM$  with all its properties for the velocity and acceleration, etc. (see chapter III, Construction of Keplerian Ellipse).

The absolute velocity is equal to the vector sum of transport and relative velocities (formula 5a). The absolute acceleration is equal to the vector sum of the three accelerations: translational, relative and Coriolis (formulas 6 and 6a).

As can be seen from the other data, the translational motion which is a rotation of the planet around the  $OZ$  axis in the Laplace plane, is obtained by adding two main oscillatory motions and the pendulum-like motion; therefore, according to Fourier's theorem, from the periodic motions of the planets of the solar system, we have obtained the oscillatory motions (formulas 8 and 10), which when added give the Keplerian motion).<sup>1</sup>

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<sup>1</sup> Since during the motion of the planet, according to formula (8), the axis of rotation can easily change its direction (not fixed), then, as is known from mechanics, the external forces, i.e. the relation expressed by formula (10) and independent of time, in the first approximation, according to the Stockwell' tables (see Subbotin, Celestial Mechanics, vol. II, p. 291), must cause not only the oscillation of the translational motion plane around the x-axis, but create in the second approximation some curvature of the orbit itself (a similar phenomenon is described in the book by Zaykina, Mechanics, pp. 155-162, §61 and by A. Eichenwald, Theoretical Physics, part II, Mechanics, pp. 175-185).

## §6. ACCELERATION DIRECTION AND ITS EXPRESSION IN TERMS OF ANGULAR AND SELECTOR VELOCITIES

The acceleration direction is determined from the formulas:

$$\cos(Gx) = -\frac{G_x}{G} = -\frac{a \cos E - ae}{r},$$

$$\cos(Gy) = -\frac{G_y}{G} = -\frac{b \sin E}{r},$$

Since

$$G_x = -E'' a \sin E - E'^2 a \cos E,$$

$$G_y = -E'' a \cos E - E'^2 a \sin E,$$

and

$$G = -E'^2 a.$$

According to the equation for the same ellipse assigned to the focus, we can write:

$$x = a \cos E - ac, \quad y = b \sin E$$

or

$$x = r \cos \varphi, \quad y = r \sin \varphi,$$

thus

$$\cos \varphi = \frac{a \cos E - ae}{r}, \quad \sin \varphi = \frac{b \sin E}{r},$$

Then

$$\cos(Gx) = \cos(rx) \quad \text{и} \quad \cos(Gy) = \cos(ry),$$

which suggests that the acceleration is directed to the focus and is equal in magnitude to (see formula 7):

$$G = -E'^2 a.$$

Here, one should give some explanation of formula (7) from which wrong conclusions are sometimes deduced.

We substitute

$$E' = n \frac{1}{1 - e \cos E},$$

into the obtained value of the absolute acceleration expressed by formula (7) and obtain:

$$G = -E'^2 a = -n^2 \rho,$$

where  $n$  is the daily mean motion

$$\rho = \frac{a}{(1 - e \cos E)^2}$$

Substituting here the angular velocity value from the formula

$$E' = \frac{2K}{br},$$

we get

$$G = -E'^2 a = -\mu^2 \frac{1}{r^2} = -n^2 \rho, \quad (11)$$

where for all planets

$$\mu^2 = \frac{4k^2}{b^2} a = \text{const.}$$

It turns out that the acceleration is directly proportional to the distance when it is expressed in terms of the angular velocity, and inversely proportional to the square of the distance, when it is expressed in terms of the sector velocity.

These expressions often occur in the course of physics, for example, for the centripetal acceleration, which, depending on the data, is directly proportional to the distance, and in other cases is inversely proportional to it (see I. Sokolov, *Methods of Physics*, p. 237).

All these expressions (5a), (6a) and (11) have their physical meaning and clearly express the physical laws. For example, consider the ellipse obtained by adding the harmonic oscillatory motions and the Keplerian ellipse.

Let us write the path, velocity and acceleration formulas and compare them:

**Ellipse, harmonic (sinusoidal) oscillatory motion**

Equation

$$x = a \cos \Omega t, \quad y = b \sin \Omega t$$

Angular velocity

$$\Omega = \frac{2K}{ab}.$$

Velocity

$$v = \Omega \sqrt{r_1 r_2} = \Omega \lambda,$$

**Keplerian ellipse**

Equation

$$x = a \cos E, \quad y = b \sin E,$$

where  $E = nt + \sin \alpha$ .

Angular velocity

$$E' = \frac{2K}{ab} \cdot \frac{1}{1 - e \cos E} = n \frac{1}{1 - e \cos E}$$

Velocity

$$v = E' \sqrt{r_1 r_2} = nt,$$

where

$$\lambda = a\sqrt{1 - e^2 \cos^2 \Omega t}$$

Acceleration

$$G = -\Omega^2 R = -\mu^2 \frac{1}{L^2}$$

where

$$R = a\sqrt{1 - e^2 \sin^2 \Omega t} \quad \text{and}$$

$$L^2 = \frac{a^2}{\sqrt{1 - e^2 \sin^2 \Omega t}}$$

$$\frac{a_1^3}{a_2^3} = \frac{T_1^2}{T_2^2} \quad \text{и} \quad \frac{a_1^3}{T_1^2} = \frac{a_2^3}{T_2^2} =$$

$$= \frac{\text{m}^2}{4\pi^2} = \text{const},$$

where  $n$  is the daily mean motion and

$$\mu^2 = \frac{4k^2}{b^2} a = \text{const}$$

for all planets.

These formulas characterizing the kinematic quantities of the system status do not differ in their pattern from each other: in both cases, the path, velocity and acceleration are expressed by the same values and are connected by the same regularity. This similarity of mathematical equations is an expression of the objective unity of these natural motions. In the ellipse of harmonic oscillatory motions and in the Keplerian ellipse, the accelerations are inversely proportional to the square of the distance when they are expressed in terms of the sector velocity, or are directly proportional to the corresponding distance when they are expressed in terms of the angular velocity.

Therefore, the statement that the acceleration of the planet is inversely proportional to the square of the distance is as valid as the fact that it is directly proportional to the distance, depending on the values it is expressed by.

Thus, differential equations (2) that define the law of motion of the planets of the solar system at any instant of time are characterized by obvious specific features of oscillatory motions.

where

$$l = a\sqrt{\frac{1 + e \cos E}{1 - e \cos E}}$$

Acceleration

$$G = -n^2 \rho = -\mu^2 \frac{1}{r^2},$$

where

$$\rho = \frac{a}{(1 - e \cos E)^2} \quad \text{and}$$

$$r^2 = a^2 (1 - e \cos E)^2$$

$$\frac{a_1^3}{a_2^3} = \frac{T_1^2}{T_2^2} \quad \text{и} \quad \frac{a_1^3}{T_1^2} = \frac{a_2^3}{T_2^2} =$$

$$= \frac{\text{m}^2}{4\pi^2} = \text{const},$$

## §7. TRANSLATIONAL AND RELATIVE MOTIONS OF A PLANET IN POLAR COORDINATES

To make it more convincing, consider the Keplerian ellipse in polar coordinates:

$$x = r \cos \varphi, \quad y = r \sin \varphi, \quad (12)$$

where  $r$  is the radius-vector from the focus,  $\varphi$  is the true anomaly.

Taking the velocity and acceleration projections on the axis of polar coordinates, and bearing in mind that the absolute velocity is equal to the diagonal of the parallelogram constructed for the translational and relative velocities, and the absolute acceleration is equal to the vector sum of the three accelerations: translational, Coriolis and relative, we can write

$$v^2 = (r')^2 + (r\varphi')^2 \quad \text{and} \quad G^2 = (r'' - r\varphi'^2)^2 + (r\varphi'' + 2r'\varphi')^2 \quad (13)$$

where  $r\varphi'$  is the transport velocity directed along the  $\varphi$  axis called sometimes the translational velocity (see Buhholz, *Mechanics*, p.294; Baev, Popov et al., *Astronomy*, p.151);

$r'$  is the relative velocity directed along the  $r$ -axis and called sometimes the radial velocity (see Buhholz, *Mechanics*, p.294; Baev, Popov et al., *Astronomy*, p.151);

$r\varphi''$  is the tangential component of the translational acceleration directed along the  $\varphi$  axis (see Nikolai, *Mechanics*, vol.1, p.184);

$r\varphi'^2$  is the normal component of the translational acceleration directed along the negative  $r$  axis (ibidem);

$r''$  is the relative acceleration directed along the  $r$  axis (ibidem);

$2r'\varphi'$  is the Coriolis acceleration directed along the  $\varphi$  axis (ibidem).

Substituting the corresponding values into formula (13), we get:

$$v^2 = (r')^2 + (r\varphi')^2 = (E'a)^2 - (E'f \cos E)^2 = E'^2 r_1 r_2.$$

Similar to the above (see formula 5), we again have obtained the same values and the same velocity components.

We have the same for the acceleration

$$G = \sqrt{(r'' - r\varphi'^2)^2 + (r\varphi'' + 2r'\varphi')^2} = -E'^2 a = -n^2 \rho = -\mu^2 \frac{1}{r^2},$$

where  $n$  is the daily mean motion, and



$$\rho = \frac{1}{(1 - e \cos E)^2}.$$

All mathematical proof of the law of gravitation without regard to the form it is given, reduces essentially to the equations

$$G^2 = (r'' - r\phi'^2)^2 + (r\phi'' + 2r'\phi')^2 \quad (14)$$

or in the geometrical form

$$\vec{G} = \overrightarrow{r'' - r\phi'^2} + \overrightarrow{r\phi'' + 2r'\phi'}.$$

where  $G$  is the total acceleration of the planet during its revolution around the Sun;

$r'' - r\phi'^2$  is the acceleration component along the radius-vector, i.e. the radial acceleration;

$r\phi'' + 2r'\phi'$  is the acceleration directed perpendicular to the radius-vector, i.e. the transversal (translational) acceleration (see Buhholz, Mechanics, vol.I, p.294; Suslov, Analytical Mechanics, vol.I, p.85, and others);

These formulas give us immediately the expressions of radial  $w_r$  and transversal  $w_p$  acceleration components:

$$w_r = r'' - r\phi'^2 \quad \text{и} \quad w_p = r\phi'' + 2r'\phi'$$

with  $w_p = 0$ .

“Thus, during the motion of the planet around the Sun it is only affected by the radial acceleration, i.e. the force acting on the planet is constantly directed towards the center of the Sun” (Popov, Baev et al. Astronomy, ed. 1940, p. 150-151).

This conclusion concerning the acting force of the Sun is beneath all criticism.

Such speculative fables are very harmful for the success of the positive sciences; in the lectures of popular astronomy and physics they are passed off as the positive truth, and the consequences arising therefrom are accepted for certain by others without reserve.

But if we take a second look at these mathematical formulas, we can immediately see that this conclusion is only a mere assumption passed off as a fact.

Indeed, what are the values

$$w_r = r'' - r\varphi'^2 \quad \text{и} \quad w_p = r\varphi'' + 2r'\varphi'.$$

They are the projections of the acceleration vector of a moving body on the axis of polar coordinates (see Nicolai, Lectures on Theoretical Mechanics, vol. I, p. 182), whereas the actual acceleration vectors can lie in other and even different planes.

“To be more precise, we have denoted the acceleration projection to the  $\mu$  axis of polar coordinates by  $R$ ” (Suslov, Analytical Mechanics, vol. I, p.85).

If we, based on the laws of mechanics, are able to calculate the projections  $w_r$  and  $w_p$  of the actual acceleration, we will know both the magnitude and the direction of the acceleration.

On the other hand, considering the values for  $w_r = r'' - r\varphi'^2$ , we note that this projection along the radius-vector is the projection of the resultant of two accelerations: the relative acceleration, the projection  $r''$  of which is directed along the axis  $r$ , and the normal component of the translational acceleration, the projection  $r\varphi'^2$  of which is also directed along the negative axis  $r$  (to the center of rotation) (see Nicolai, Lectures on Theoretical Mechanics, vol. I, p. 185).

Consequently, the statement that the projection of the resultant of the two accelerations (the relative acceleration and the normal component of the translational acceleration which may lie in different planes) is due to the attractive force of the Sun can be made only by people who never consider the phenomenon in terms of their origin, but want to relate these phenomena to the biased notions of the gravitation theory.

Even theoretical Newtonian mechanics cannot deny the fact that the central force of solar attraction, giving the acceleration inversely proportional to the square of the distance, is “as if” the resultant of two forces: the central and some additional force.

“This equation shows that in the case of central forces, the relative motion of the point along the radius-vector occurs “as if” under the action of two forces – the force  $F$  and some additional force  $m\frac{C''}{r^3}$ ” (Buhholz, Mechanics, vol. I, ch.VI, §5, p.293).

Unfortunately, there is nowhere indicated what this additional force  $m \frac{c^2}{r^3}$  is. We can easily find this force. We know that  $\frac{c^2}{r^3} = \frac{r^4 \varphi'^2}{r^3} = r\varphi'^2 = r\varphi'^2$ , and this, as mentioned above, is a normal component of the translational acceleration directed along the negative axis  $r$  to the center of rotation.

Hence it appears that a projection of a certain resultant vector obtained from two component vectors:  $m r\varphi'^2$  of the translational motion and  $m r''$  – of the relative motion, is the attractive force of the Sun!!

The resultant of these two forces (and even its projection) is never a central acting force, it does not really exist as a central unit acting force; there are actually components of the force and their resultant expresses only the magnitude and the direction of the joint action of two or more forces, i.e. the total forces.

The resultant force acting as a unit force does not exist, it is the essence of “the individual”; therefore, there is no attractive force as a single action of the Sun.

“The general exists only in the individual and through the individual ... Every general is a particle or side, or essence of the individual” (Lenin, Philosophical Notebooks, p. 27).

It is equally wrong to say that the transversal component of acceleration

$$w_p = r\varphi'' + 2r'\varphi'$$

reflects the inertial motion. It is common knowledge that  $r\varphi''$  is the projection of the tangential component of the translational acceleration,  $2r'\varphi'$  is the Coriolis acceleration (see Nikolai, Mechanics, vol. I. p. 184).

These two vectors ( $r\varphi''$  and  $2r'\varphi'$ ) according to the law of “action and reaction” in the selected system of coordinates are always equal and oppositely directed. Thus,  $w_p$  is the projection of the resultant of two equal and oppositely directed accelerations and in no case can reflect the inertial motion.

The existence of the Coriolis acceleration and the tangential component of the translational acceleration shows that in addition to the attractive

force of Newtonian mechanics, there must also be some other force (see. Buchholz, Mechanics, vol. I, p. 293).

Therefore, formula (13) shows that during the motion of planets around the Sun, we have two motions – translational and relative; the resultant of their accelerations is directed toward the center of rotation, i.e. to the focus.

The translational motion for the velocity and acceleration has certain projections on the axis of the polar coordinates:  $r\varphi'$ ;  $r\varphi''$  and  $r\varphi'^2$ , and the relative motion for the velocity and acceleration also has certain projections on the axis of the polar coordinates:  $r'$  and  $r''$ .

Hence, it would be wrong to say that the vectors of the actual acceleration of both actual motions (translational and relative) lie in the same plane; conversely, one can definitely say that the projections of the above acceleration vectors lie exactly in the plane onto which we project them; and the vectors of these motions (i.e, the motion itself ), as shown above, are in other and even different planes: the first – in the XOY plane and the second – in the NOM plane (see Figure 2).

These equations indicate that the translational motion is a rotation about the axis passing through the origin and is a periodic, oscillatory rather than an inertial motion. The relative motion is a periodic, oscillatory motion but not attractive.

It turns out that the physical reason for the elliptical shape of the planetary orbits is a simple and inevitable consequence of one general property of matter, which we all see and know, but to which we do not want to pay any attention, because it is too simple. This is the oscillatory motion of electrons, atoms, molecules and bodies.

We are witnessing the fall of the electric fluid, magnetic fluid and caloric, and we will eventually witness the fall of the attractive force of the Sun, which now forms the basis of everything and which, according to Ramsay and Ostwald, has been binding science for 300 years (see Ramsay, Ostwald, From History of Chemistry, p. 101).

Similarly, we have for the Keplerian ellipse equation:

$$x=R\cos\Theta \qquad y=R\sin\Theta$$

where  $R$  is the radius-vector from the geometrical center

$$v^2=(R\Theta')^2+(R')^2=E'^2r_1r_2 \text{ and } G^2=(R''-R\Theta')^2+(R\Theta''+2R'\Theta')^2=(E'^2a)^2.$$

Here, the translational and relative motions are also projected onto the same plane, but the projections of the resultant of the velocity and acceleration are taken on the axis of polar coordinates  $R$  and  $\Theta$ .

In the same manner,  $R''$  is the acceleration of the relative motion directed along the radius  $R$ , whereas  $R\Theta''$  is the acceleration of the translational motion also directed along the axis  $R$ .

Similar to the considered case,  $R\Theta''$  is the tangential component of the translational acceleration, and  $2R'\Theta'$  is the Coriolis acceleration.

With this system of coordinates the tangential component of the translational acceleration  $R\Theta''$  does not coincide with the Coriolis acceleration  $2R'\Theta'$  either in magnitude, or in direction.

The resultant of all these accelerations is the acceleration of planets on the orbit  $G = -E'^2a$  and is directed to the ellipse focus.

It is wrong to state that for this case as well as for the case analyzed above (see formula 13), these accelerations are caused by the attractive force of the Sun, since these acceleration vectors are only projections of the actual acceleration vectors, and their resultant is a projection of the resultant of the accelerations of two motions lying in different planes.

Clearly, both the resultant itself and its projection are only geometric representation and conventional reflection, a symbol of the acceleration vector (Newton force), not really existing as the separate-individual, without any connection that leads to the general.

Consequently, differential equations (2) for planetary motion are the resulting accelerations of oscillatory motions: translational and relative, lying in different planes.

By addition of these motions the Keplerian ellipse (planetary orbit) is obtained with all its specific properties for the path, velocity, acceleration, angular velocity, etc. The translational motion is a revolution of a planet around the fixed axis (it is obtained by adding two main oscillating motions), and the relative motion is a pendulum-like oscillation with the period equal to the period of rotation (in the limit), and with preservation of the oscillation plane.

Thus, with all mathematical rigor it is proved and dialectically confirmed that the process of existence of the solar system is possible on the basis of the theory of oscillatory motions, i.e. due to the interaction of attraction and repulsion.

It is impossible to describe, either mathematically or ideologically, a picture of the world – the motion of the planets of the solar system only by Newtonian attraction without any repulsion.

Taking into account the above (§§ 3, 5, 6), it should be concluded that both from the mathematical and physical standpoint the motion of the planets of the solar system is a typical case of oscillatory motions.

## CHAPTER II

### ON SOME PROBLEMS OF CELESTIAL MECHANICS

#### §8. FORMS OF ORBITS DEPENDING ON THE RELATIVE MOTION

As is known from theoretical mechanics, the shape of the orbit of the Keplerian motion is perfectly determined by the total energy sign  $E$  of a moving point

$$E = -\mu^2 \frac{m}{2a} = \frac{mv^2}{2} - \mu^2 \frac{m}{r} = \text{const} \quad (15)$$

(see A. A. Eichenwald, Theoretical Physics, part II, p.67).

After relevant transformations the following conclusion can be made:

“The radius-vector and the absolute velocity of the planet at any instant of time determine the semi-major axis” according to the formula:

$$v^2 = E^2 r_1 r_2 = \mu^2 \left( \frac{2}{r} - \frac{1}{a} \right)$$

(see Subbotin, Celestial Mechanics, p.37, and Buhhokz, Theoretical Mechanics, p. 300).

When  $v^2 = \mu^2 \frac{1}{a}$ ,  $e=0$  – orbit circle

when  $v^2 = \mu^2 \frac{2}{r}$ ,  $e=1$  – orbit parabola

when  $v^2 < \mu^2 \frac{2}{r}$ ,  $e < 1$  – orbit ellipse

when  $v^2 > \mu^2 \frac{2}{r}$ ,  $e > 1$  – orbit hyperbola

Thus, the shape of the orbit is associated with the velocity of the planet, and it would be more properly to state: the given tangential velocity in comparison with attraction is responsible for a particular shape of the conic section.

These findings seem rather uncertain (see formula 1a) and somewhat artificial; they say nothing about the cause of the changes (semi-major axis) in the amplitude, velocity or total energy, which determine the shape of the orbit.

Considering the motion of the planets of the solar system as the oscillatory motion and determining the shape of the orbit according to the laws of oscillatory motions, we obtain more interesting and rather substantial conclusion on the problem.

We have established that, according to formula (8), the main motion of planets is a revolution of a planet around a certain axis in a circle in the Laplace plane

$$x_A = a \cos E, \quad y_A = a \sin E, \quad Z_A = 0.$$

This motion differs partially from the relative motion and is also of oscillatory nature (see formula 10)

$$\xi = \frac{a}{2} \cos 2\alpha, \quad \eta = 0, \quad \zeta = \frac{a}{2} \sin 2\alpha,$$

which hereinafter will be considered as a “perturbing oscillation of the system”, or a “coupling” imposed on the motion of the planet.

Both of these motions, lying, as is known, in different planes, are real, they are actually observed (see Subbotin, *Celestial Mechanics*, vol. II, p. 291, Stockwell’s table).

The frequency of the oscillatory motion, or, as it is stated in mechanics, the system frequency and the frequency of the perturbing oscillation of the system are connected with each other by formula (9):

$$e \sin E = \sin \alpha.$$



If the period of natural oscillations of the system coincides with the period of coupling of perturbing oscillations of the system,  $\sin E = \sin \alpha$ , i.e., for  $e=1$  a resonance phenomenon<sup>1</sup> occurs.

The same can also be obtained from the famous Kepler's equation ( $E' = n + E' \cos E$ ) for  $e=1$ :

$$E' = \frac{1}{1 - e \cos E}.$$

When  $E$  approaches  $2\pi$ , the angular velocity  $E'$  increases to infinity and an asymptotic motion is obtained. It is well known from theoretical mechanics. "When the frequency of the perturbing oscillations is equal to that of the self-oscillations, the amplitude of the forced oscillations increases indefinitely" (see Buchholz, Mechanics, vol. II, p. 283, and Nikolai, Mechanics, vol. II, p. 73).

When  $e < 1$ , i.e., the relation  $e \sin E = \sin \alpha$  is valid, and, as we see in the first approximation, gives the equation  $x = a \cos E$ ,  $y = b \sin E$ , i.e., the ellipse equation with semi-axes  $a$  and  $b$ .

Passing to the second approximation, consider the differential equation for planetary motion (formula 2) in the form

$$x'' + \frac{m^2}{r^3} x = 0 \quad \text{and} \quad y'' + \frac{m^2}{r^3} y = 0.$$

Substituting the corresponding value  $\mu^2$ , we get:

$$x'' + k^2(1 - e \cos E)x = 0 \quad \text{и} \quad y'' + k^2(1 - e \cos E)y = 0,$$

where  $k^2 = \frac{\varphi'^2}{\cos^2 \beta}$ ,  $\varphi$  is the true anomaly,  $E$  is the eccentric anomaly,

$E = nt + e \sin E$ ,  $n$  is the daily mean motion,  $\beta$  is the angle of eccentricity.

After integration, the equations of this form give a trajectory, a curve very near to an ellipse. This curve, in contrast to the ellipse, will not close, and the resulting curl will be near to the ellipse with semi-axes  $a$  and  $b$ ; however, the direction of the semi-axes  $a$  and  $b$  is not constant, and will

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<sup>1</sup> "It is known that the resonance phenomena in celestial mechanics are also possible at other frequency ratios, e.g. 1:2, i.e., for the coupling frequency acting on the system twice as high as the frequency of the system" (second-order resonance) (see Ritov, Teaching of Oscillations and Waves, p. 26).

slightly turn in the same direction in which the point moves along an ellipse. It is the rotation of the line of apsides. There is a graceful experiment of the rotation of the line of apsides (see Krylov, Lectures on Approximate Calculus, pp. 360-369; Eichenwald, Theoretical Physics, pages 182, 183).

«In astronomy ...the motion similar to that described above is typical for the Moon in the vicinity of the Earth, and indeed, the equation of the form

$$\frac{d^2u}{dt^2} + n^2(1 + 2\alpha \cos kt)u = 0$$

is very important in the theory of Moon motion” (see A. N. Krylov, Lectures on Approximate Calculus, p. 369).

When  $e > 1$  with  $e \sin E = \sin \alpha$ , the coupling is impossible, it is disturbed, the point shifts from the coupling and the progressive motion occurs.

When  $e = 0$ , the coupling that causes the perturbation of the system is absent, then  $\alpha = 0$ ,  $E' = n$ , and the planet moves in a circle with constant angular velocity in the Laplace plane (see Subbotin, Celestial Mechanics, vol. II, p. 20).<sup>1</sup>

Therefore, in the absence of disturbing forces, i.e. of the relative motion with respect to the medium, the translational motion coincides with the absolute motion, and the circular motion of the planet is a result of the addition of two harmonic oscillatory motions

$$x = a \cos nt \quad \text{и} \quad y = a \sin nt, \tag{16}$$

in which the planet takes part.

Here,  $n$  is the angular velocity at the harmonic oscillatory motion, so-called “daily mean” motion in astronomy.

This implies that the elliptical pattern of the planetary orbits is the first perturbed motion, and in general the coupling superimposed on the motion of the planet (formula 10) determines unambiguously the shape of the orbit: circle, ellipse, parabola or hyperbole.

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<sup>1</sup> “If the perturbation function R involved in the equation is zero, we have the case of an unperturbed motion that takes place in the invariable plane”.

“If the body does not make any relative motion with respect to the medium, its translational motion coincides with the absolute motion (see E.L. Nikolai, Lectures on Theoretical Mechanics, vol. I, p. 166).

These conclusions are consistent with the theory of oscillating motions and are discussed in detail in the course of theoretical mechanics in the section “Oscillatory motions with coupling”.

Studying such kind of motions, as is known from theoretical mechanics, we obtain the following conclusions:

1. The trajectory can be in the form of a circle, ellipse, parabola, or hyperbola depending on a superimposed coupling (Kepler’s first law).

2. The trajectory takes the shape of an ellipse with constant sector velocity (Kepler’s second law).

3. In most cases, the trajectory is an open curve.

4. Since the imposed coupling or, more precisely, the periods of the main motion – rotary and pendulum-like are incommensurable, the period of oscillation along the  $b$  axis of the ellipse is somewhat shorter than that along the  $a$  axis, and as a result the direction of the axes changes. The semi-major axis turns slightly and in the direction in which the motion along the ellipse takes place, i.e., in the direction of increasing sector velocity.

5. The speed of rotation of the ellipse axes is proportional to the initial angular velocity and is characterized by the ratio of axes of the ellipse, i.e., depends on the eccentricity.

6. The motion plane slightly oscillates (see. Subbotin, Celestial Mechanics, vol. II, p. 291, Stockwell table).

The analogous conclusions were also obtained for some similar cases of the motion of a point with coupling (see A.A. Eichenwald, Theoretical Physics, Part II, pp. 175-185; S.E. Haikin, Mechanics, pp. 156-162, A. Krylov, Lectures on Approximate Calculus, pp. 360-369).

All these cases are actually observed in planetary motion.

The above conclusions make it clear that the attraction and the uniform motion cannot reflect the picture of the Universe; it is necessary to seek other conclusions, more realistic and acceptable in terms of the physical reality of the world picture.

All discrepancies such as: motion of the apsides axis (Mercury), reverse motion of the planet satellites, motion of the Moon and the lunar nodes, solar system stability, Bode law, etc., that are inexplicable by the laws of attraction can easily be explained by the laws of the oscillatory motions and not only explained, but follow therefrom as necessary consequences of these motions.

According to Newton, phenomena occur “that way and not otherwise,” because the world is built “precisely so that”: in order the apple fall on the ground, the Earth must attract; in order the Moon revolve around the Earth, the Earth must attract; if we add here Engel’s statement “cats were created to eat mice, mice (were created) – to be eaten by cats “; it is possible to conclude that the world is built so that “there should be an attractive force in order to prove the wisdom of the Creator.

The basic law of the gravitational force would be valid not because the world was built exactly “that way”, but because the same law should remain valid for various patterns of the Universe, “whereas if there were no gravitational forces at all, the laws of dynamics could exist and have their own meaning and form“ (see. Khaikin, Mechanics, p. 268).

If the law of gravity were as inevitable as other laws, then using it, much better explanation could be achieved than by using quite an arbitrary assumption of the gravitational force without its relation to other kinds of motion occurring among diverse natural phenomena, whereas there exist well-known phenomena such as the motion of the Moon, the transit of comets near the Sun’s surface without changing their orbits, fluctuations in lunar longitude, the motion of the perihelion of planets, particularly Mercury, Bode law, for which the Newtonian metaphysical world and Einstein’s idealized – curved world are powerless.

Thus, there are no motions falling out of the common link, and we have to give up the force of gravity. A dialectically thinking materialist can say: there is no interaction in the sense it is given by Newton’s law

$$F = - \gamma \frac{Mm}{r^2}$$

for celestial bodies, and it does not exist at all, and therefore, “now it is time for philosophy to go up again to the heaven so that after Copernicus, Galileo and Kepler re-examine the planetary paths and cognize their laws to make evident the identity of reason and nature on their basis” (see Hegel, Collected Works, vol. XVI, De orbitis planetarum, p. 2).

It is necessary to build a new theory of motion of celestial bodies based on this dialectical logic in close connection with the mathematical derivations of terrestrial and celestial mechanics obtained by experimental observations of the motions of celestial bodies and bodies on the Earth’s surface.

### **§9. RELATION BETWEEN ECCENTRICITY AND INCLINATION OF THE ORBIT WITH LAPLACE PLANE**

Examining formula (9), i.e. the angle  $MON=\alpha$  (Fig. 2) for the pendulum-like oscillation of the planet, we see that changing, it comes in the limit to the angle  $QOL=\beta$ ; then in the limit

$$e=\sin\beta. \tag{17}$$

This also follows from formula (9) for  $E=\frac{\pi}{2}$  as well as from formula (9a) for  $\cos\beta=\frac{b}{a}$ , whence it follows that

$$1-\cos^2\beta=\sin^2\beta=\frac{a^2-b^2}{a^2}=e^2, \text{ т. е. } e=\sin\beta.$$

We conclude that the inclination of the planetary orbit from a certain plane depends entirely on the relative motion (Equation 10) and is closely related to its eccentricity. The angle  $\beta$  in astronomy is called the “eccentricity angle.”

Thus, to determine the orbits, it is sufficient to know five elements, since the orbit inclination  $i$  is associated with the orbit eccentricity  $e$ , i.e.  $i=\beta$  where  $\sin\beta=e$ .

If, using formula (17), we calculate the angle  $\beta$  for each planet, depending on the eccentricity  $e$  from its orbit, the main plane of rotation, i.e. the plane of the translational motion of all the planets will be the “Laplace plane” (see the diagram in Fig. 3).

The Stockwell’s table shows that the planet is involved in two motions: the motion in a circle  $PLO$  in the Laplace plane (the first and the main) and the pendulum-like motion in the plane  $MON$ , intersecting the Laplace plane  $PLO$  at a certain angle (see Fig 2, formulas (8) and (10)), and from their addition the Keplerian ellipse is obtained (chapter III).

Planets	Range of $e$ variation according to Stockwell tables		Inclination of an orbit according to the formula $e=\sin\beta$ , i.e. the angle of eccentricity		Approximate data of the inclination of an orbit from the Laplace plane according to Stockwell’s tables	
	from	to	from	to	from	to
Mercury	0,121	0,232	7°0'	13°24'	7°0'	9°17'
Venus	0,000	0,087	0°0'	5°0'	0°0'	5°18'
Earth	0,000	0,078	0°0'	4°30'	0°0'	4°52'
Mars	0,018	0,140	1°2'	8°6'	1°9'	7°9'
Jupiter	0,025	0,061	1°25'	3°30'	0°14'	2°50'
Saturn	0,012	0,084	0°42'	4°48'	0°47'	2°33'
Uranus	0,012	0,078	0°42'	4°30'	0°46'	2°33'
Neptune	0,006	0,015	0°20'	0°50'	0°34'	0°47'
Pluto	0,25		14°30'		17°8'	

The following table is compiled in such a way that in the first row the limits of variation of the eccentricity of the planetary orbit are given according to Stockwell’s tables (approximately), the second row shows the angle of eccentricity – the orbit inclination according to the formula  $e = \sin\beta$ , i.e. the value of the angle  $\beta$ , the third row – the inclination of the planetary orbit from the Laplace plane according to the Stockwell’s data.

If we take into account the approximate methods of calculating the change in the eccentricity of the orbit (the period of variation 250,000 years) and the difference in its inclination, it can be said that the data of inclination of the planetary orbit from the Laplace plane almost agree with the angle of the eccentricity of the planet (see the diagram in Fig. 3).

This conclusion is confirmed mathematically (see Subbotin, *Celestial Mechanics*, vol.1, p.33):

$$2k \cos i = x \frac{dy}{dt} - y \frac{dx}{dt} = \cos \beta nab,$$

where  $i = \beta$ .

With allowance for all these statements, we must make a very important conclusion about the nature of planetary orbits.

It is proved with all mathematical rigor that the elliptical shape of the planetary orbits is obtained as a result of the imposed coupling (Formula 10) upon their circular motion, and therefore, it would be correct if we change the first Kepler's law and present it in the form given by Copernicus: All planets revolve around the Sun in circles the common center of which is the Sun.

The Keplerian ellipse is the first perturbed motion. Due to the imposed coupling (formula 10), the plane of the planetary orbit, varying with a period of tens to hundreds of thousands of years, gradually changes from a circle to an ellipse and back (see E. S. Haikin, *Mechanics*, §61, p. 155-162; F.R. Multon, *Introduction to Celestial Mechanics*, p. 369; M.F. Subbotin, *Course of Celestial Mechanics*, vol. II, pp. 342 and 291).

This conclusion can also be made from the theory of perturbed motions. "If the perturbation function  $R$  in the equation is equal to zero, we have the case of the unperturbed motion executed in the same plane" (see. M.F. Subbotin, *Course of Celestial Mechanics*, vol. II, p. 20). Thus, the statement of the ancient scholars, especially of the Pythagoreans, that all planets "march" uniformly in circles without any force, with the Sun in their common center, is the product of long-term observations and is the necessary result of our thinking derived from the natural phenomena

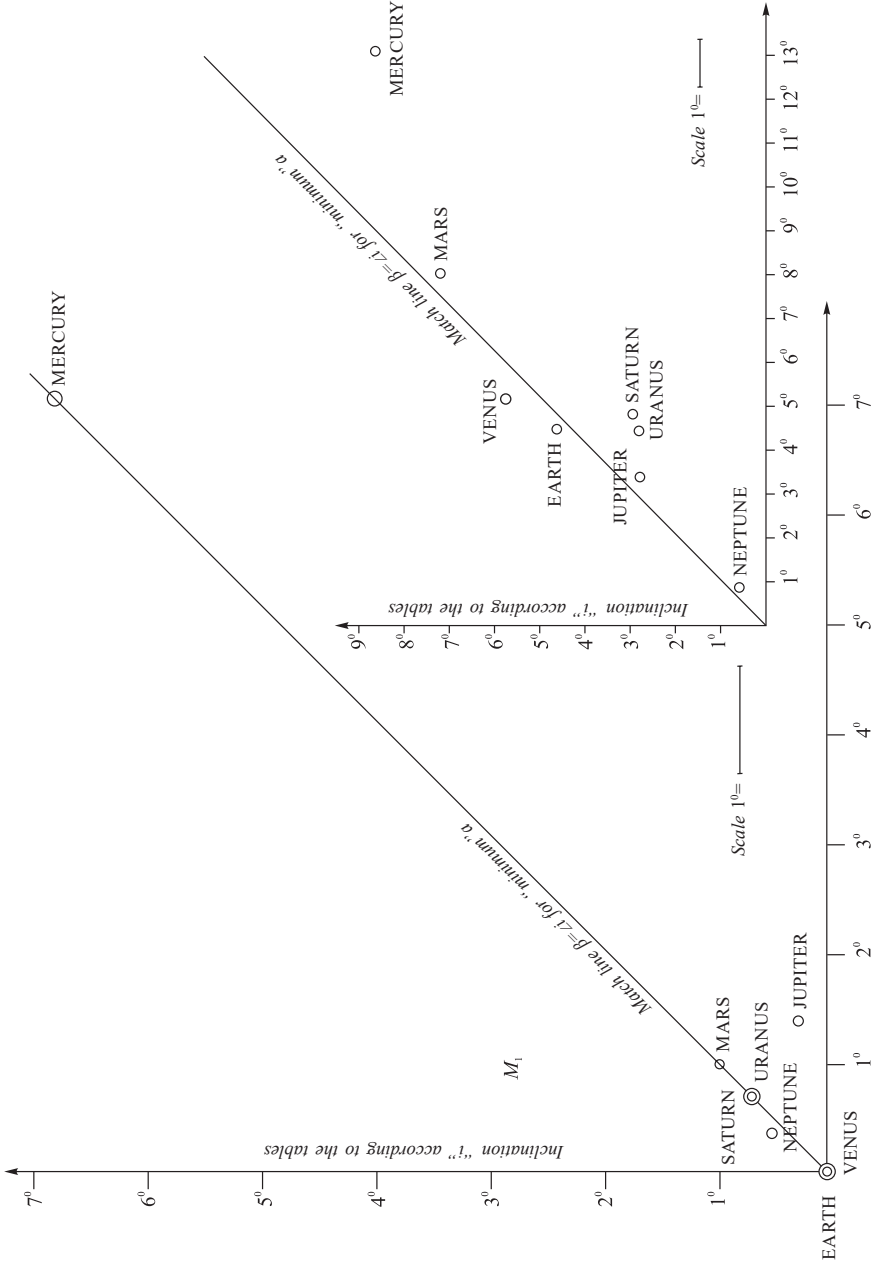


Fig. 3



by decomposition of complex natural processes, in studies of which the ancients had no shortage of speculative elements.

The circular motion itself in the absence of coupling, according to formula (16), results from the addition of two harmonic oscillatory motions:

$$x = a \cos nt \text{ and } y = n \sin nt,$$

and the coupling (formula 10) imposed on this motion gives the absolute motion:

$$x = a \cos E \text{ and } y = b \sin E.$$

The angular velocity  $E'$  is equal to the vector sum of the angular velocities of the harmonic oscillatory motion  $n$  plus the angular velocity of the relative motion  $E'e \cos E$  (since the relative motion  $NM = ae \sin E$ ).

$$E' = n + E'e \cos E.$$

Integrating this equation, we obtain the well-known Kepler's equation

$$E = n(t-T) + e \sin E = n(t-T) + \sin \alpha,$$

where  $T$  is the constant of integration, and for  $\alpha=0$ , i.e., in the absence of coupling,  $E=nt$ , and it means that if the planet does not execute relative motion with respect to the medium, the translational motion will coincide with the absolute motion according to formula (16) (see E. L. Nikolai, Lectures on Theoretical Mechanics, vol.1, p.166).

## **§10. SOME FACTS OF DISCREPANCY BETWEEN THE THEORY OF GRAVITY AND THE REALITY**

If we approach practically this question, and on the basis of the laws of gravity try to determine the laws of motion of the planets and their satellites, it will also be clear that this cannot be reached without resorting to the equation of oscillatory motion.

1. This is what Euler writes in his remarkable work "New Theory of Moon's Motion":

"No matter how much in the course of forty years I tried to solve the theory of the Moon and to determine its motion on the basis of the gravitational laws, I always faced such difficulties, that I had to interrupt

the work and further stided. With allowance for the principles of mechanics the problem is immediately reduced to three differential equations of the second order. Thus, the whole thing reduces to defining these three coordinates for any set time. Therefore, I gave three differential equations of the second order that are directly determined by mechanics.”

Academician Krylov states concerning this problem (ibid.):

“When studying this last work, I involuntarily paid attention to the fact that Euler, considering the motion in rectilinear Cartesian coordinates, in order to determine these coordinates, gets differential equations representing rather a general case of equations of oscillatory motion of material systems. The oscillatory motion is gaining more and more importance in engineering, and in many cases we have to deal with nonlinear differential equations, and if linear, then with variable coefficient, i.e. precisely with equations of the type considered by Euler in his “Theory of the Moon.”

Ibidem (p.188) we read about the equation of motion of the Moon:

“Thus, in terms of modern engineering, equations (1) represent a very general case of nonlinear oscillation equations, and we have to find not only a forced, but also a free oscillation, and the whole difficulty consists precisely in finding the latter, mainly the frequency or the period”.

Ibidem (p. 194) it is said about the equation of Moon’s motion, derived by Hill:

“Only after 106 years after the publication of Euler’s book, Hill performed his masterful transformation of equations of Moon’s motion, derived his famous equation which is equivalent to the equation which Euler did not dare to set up.

In terms of technology, differential equations of Moon’s motion are a very complex example of nonlinear equations of oscillatory motion ... because, due to the presence of the non-linear terms and the terms with variable coefficients with the unknowns, the oscillation frequency depends on their amplitude.”

After this conclusion of Euler and Hill about the force of universal gravitation and its inapplicability to the theory of Moon’s motion, as well as the fact that the equations of Moon’s motion are those of oscillatory

motion, there is no doubt that the world is governed by the laws of oscillatory motions.

2. If we consider universal gravitation in connection with other natural phenomena, with all the diverse forms of the material world, we even here must abandon the force of universal gravitation, the force standing apart among all the other natural phenomena.

An essential feature of the concept of the force of universal gravitation is its consideration beyond the idea of unity of mutually opposite forms of motion, beyond the general interconnection with other forms of motion; therefore, the gravitational force always was and is a separate property of matter, and its actions seem casual among all natural phenomena and various forms of motion.

Consideration of objects and phenomena of nature in isolation, apart from their great common link is a metaphysical way of thinking, says Engels in "Anti-Duhring."

Indeed, the scientific achievements of the XX century are so great that in this regard they are much higher than those of the previous centuries and cannot even be compared. But despite their extremely large number and variety, they form a harmonious regular picture of the world in which "the unity of the Universe", the unity of the material world is being increasingly revealed, where separate qualitative forms of motion of matter, under certain conditions, always pass into one another in certain ratios.

But what can be said about the force of universal gravitation, standing isolated among all these laws?

This isolation always put scientists onto an idea to explain the essence of universal gravitation.

Both in the past and in the present many attempts have been made to explain the phenomenon of gravitation, and many hypotheses have been proposed, such as flying particles from the interstellar space, attempts to give longitudinal waves of ether, and many others, which do not stand up to any criticism, and therefore, we are still as ignorant concerning the force of universal gravitation as Newton himself three hundred years ago.

The famous Faraday and now Einstein tried thoroughly to associate gravity with electromagnetic phenomena, but science experienced and will experience a complete failure since it is sought something that does not exist in nature.

There is no power to keep planets in their orbits. The planets, according to the ancient scholars, “march”, their motion is free and is not a tugging hither and thither (Hegel).

Centrifugal and centripetal forces holding the planet in its orbit is metaphysical nonsense (Hegel and F. Engels), and this nonsense, according to Ramsay and Ostwald, has been binding science for three hundred years.

“Now Dr. Einstein is working hard on the problem, which took him twenty-five years, and he hopes to complete this work before he dies. He tried to develop completely the “unified field theory” expressing the laws that govern the basic forces of the Universe: gravity and electromagnetism in terms of a set of mathematical equations. To appreciate the significance of these studies one must be aware that these two initial forces are the source of all natural phenomena”...

... Except for gravity, all other forces of the material universe ... are electromagnetic in nature ...

... Attempts were repeatedly made to consider universal gravitation, as a phenomenon of the electromagnetic order, but they all failed. In 1929, Einstein himself thought that he could solve this problem: then he put forth the theory of unified field, but later rejected it as incorrect (see Lincoln Barnett, *The Universe*, and the works of Dr. Einstein)

On the other hand, we can successfully state that the development of physics of the XX century follows the path of the theory of oscillations of conservative nonlinear systems.

“Note that for physics the theory of conservative systems itself is of great value...”

... First of all, since the time of Laplace, and especially after the heat was regarded as a form of kinetic energy, physicists assumed for the theory of the structure of matter that in the microcosm there act conservative

forces. On this path considerable advances have been made in the kinetic theory of gases, the crystal lattice theory, etc.

... So-called old quantum mechanics, in order to determine the stationary states of the atom, used a conservative model, only postulating a certain recipe to define the arbitrary constants ...

... Even in new quantum mechanics that abandoned the space-time description of the motion of individual particles, it is necessary to know the Hamiltonian function of the “perfect model of the atom,” before you write Schrodinger equations...

... We can consider from a certain standpoint the whole development of mechanics of the atom as the development of conservative Hamiltonian mechanics “(see Andronov and S.E. Haykin, *Theory of Oscillations*, p. 88).

Now, the experimental data give reliable information on the existence of free energy levels in the nucleus, and the “distribution of the nuclear levels should be different from that of the atomic levels” (see D. Stranatan, *Particles in Modern Physics*, page 417; E.V.Shpol’skii, *Atomic Physics*, vol. II, pp. 446-448). Nevertheless, the existence of “resonance energy” indicates that the particles of the atomic nucleus execute high-frequency periodic oscillating motions...

3. Taking the attractive force as the basis of the Universe structure, it is difficult to understand why the Moon revolves around the Earth during the revolution of the center of gravity of the Earth-Moon system around the Sun. It is known from Newton’s law that the force of attraction of the Moon by the Sun is twice as high as that of the Moon by the Earth.

The question arises, why during the new moon, the Moon moves toward the Earth, describing an elliptical orbit, and does not remain between the Earth and the Sun, or does not approach the Sun in a slow clotting spiral?

It is known that in this case, both bodies – the Earth and the Moon are on the same side of the Sun (and in such cases the perturbing forces are added algebraically, i.e. the perturbing force is directed toward the perturbing body – the Sun).

By the character of the lunar orbit it would be quite natural to consider the Moon as a planet which moves directly around the Sun, however, because of the impossibility to solve this problem, one began to adhere to the so far accepted opinion that in the Sun-Moon-Earth system the center of the Earth is stationary and “ the Moon and the Sun move around the stationary Earth, and both describe a Keplerian ellipse “(see. Subbotin, *Celestial Mechanics*”, vol. II, p. 318, and Euler, *New Theory of Lunar Motion*, p. 165).

In principle, such a coordinate system for the Moon, according to general relativity, is supposedly equivalent to any other, at least to that of Ptolemy, but then the Sun will be in the focus of the orbits for other planets.

But who, when studying the solar system, will use the coordinates at rest with respect to the Earth, i. e. return to the Ptolemaic system of the world. But this exception is made for the Moon. The question is why?

To build the orbit of the Moon always concave toward the Sun with the points of intersection with the orbit of the Earth, according to laws of gravitation, does not seem possible.

“How many times in the course of forty years, I have tried to develop a theory of the Moon, and to determine its motion on the basis of the gravitational laws, but every time I faced such difficulties, that I had to interrupt the work and the subsequent study” (Euler, *New Theory of the Moon*).

4. No matter how much I wish to believe, but it is hard to imagine that the secular perturbations for the planets and their satellites dispersed in the Universe were always formed in such a way that for all the planets and their satellites with different periods of revolution, the line of apses rotated in one direction and moreover in the direction of the increasing sector velocity, whereas, according to the theory of gravity, no rotation of the line of apses occurs, and according to the theory of oscillatory motion, the line of apses must turn to the direction of the increasing sector velocity.

We must as well add that between the theory of planetary motion and their satellites (based on gravity, inertia) and the rotation of the line of apses, an obvious discrepancy for some planets was established.

The discrepancy is so great for Mercury that for this purpose specially invented but unproductive hypotheses were put forward. The hypothesis of perturbing influence of the zodiacal light, the hypothesis of intermercurial planet, the hypothesis of incomplete sphericity of the Sun, Einstein's hypothesis – bending of the beam, Hall's hypothesis used by Newcombe to make most accurate tables for Moon's motion:

$$F = -1^2 \frac{Mm}{r^N}$$

where  $N=2,000000162$ .

But the new theory of the Moon, developed by Brown, showed that Hall's hypothesis cannot be applied to the Moon.

5. If we direct our attention to the stellar world, a lot of facts leading into deadlock will be revealed, and we have to examine various obscure hypotheses to explain all the phenomena of the infinite Universe by gravity.

The Sun with all its system moves similarly and probably also describes an elliptical orbit in the vast space, without having a huge massive center.

It is hard to believe that the motion of the Sun and planets in their orbits is due to the gravitation of cosmic masses.

6. Recently, spectroscopic observations of astronomers have shown certain features of systematic motion of galaxies, all of them being the far outer galaxies that gradually move away from each other and from our solar system. On the basis of this established fact, the employee of California Institute of Technology, cosmologist H. P. Robertson, calculated that in a few billion years –in the cosmic future, these galaxies will come together again, i.e., the separation process will be replaced by the approach process.<sup>1</sup>

According to the hypotheses of Belgian cosmologist Abbe Lemaitre and the employee of California Institute R. S., Tolmen, "the process of

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<sup>1</sup> Approach and separation of "fixed" stars to and from their center and rotation of the line of apses was known as far back as Arab mathematicians and astronomers of the VIII century – Tsabit-ben-Kora, Al Batani and others. (Suter, Brief History of Mathematical Sciences, pp.115-116; A.Berry, pp. 78 and 104).

expansion of the Universe is just a temporary state, which someday in the cosmic future will be replaced by the process of contraction.<sup>1</sup>

“The Universe, according to Tolmen, is a pulsating balloon, with cycles of expansion and contraction following perpetually one after the other” (see Lincoln Barnett, *The Universe*, and the works of Dr. Einstein with a Foreword by A. Einstein).

If we purge of this trend the teaching of cosmologists H. P. Robertson, Abbe Lemaitre and R. S. Tolmen developed under the influence of the hypothesis of the space-time continuum of A. Einstein and his closed Universe and consider this new theory about the Universe from the standpoint of the “unity of the Universe”, i.e. consider the processes occurring in the Universe as a result of the motion of matter in space and time, but not ascribe them to the space itself, pushing the motion of matter to the background, the processes observed by these cosmologists can be called in terms of modern science the “periodic processes of oscillatory motion” of approach-separation, contraction-expansion, attraction-repulsion (Democritus, Pythagoras, Descartes, Hegel, Kant, Engels).

In 1948, a cosmologist of Harvard University, Dr. Fred L. Wipli, published the book “The Dust Cloud Hypothesis”, which describes the process of contraction and separation of cosmic bodies from the center (see Lincoln Barnett, *The Universe*, and the works of Dr. Einstein, Extract from the work by Fred L. Wipli: “The Dust Cloud Hypothesis”).

Thus, according to F. L. Wipli, in the pulsating Universe, in the infinite flow of time, there occur periodic processes of creation and decay, contraction and expansion, i.e., we come spontaneously to the dialectical laws of nature, to the idea of infinitely-self-healing periodic processes in the Universe: approach-separation, contraction-expansion, attraction-repulsion, which is the main form of motion of matter, which requires neither any external forces and nor any impulses.

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<sup>1</sup> “The fact of recession of galaxies” itself, no matter how unexpected it may be, has been established so perfectly that it is beyond any doubt” (see V. A. Fock, *Theory of Space, Time and Gravity*, p. 464).



In nature, there are no separate figures, all natural phenomena are the result of periodic oscillatory motion, and they follow the general laws of oscillatory motions, without any special miracle, without special force, by their own inevitable dialectical, correct and constant laws.

The dialectical laws cannot be invented and introduced into nature from outside, they must be sought in nature, derived from it (Engels, *Anti-Dühring*).

Thus, we have considered the law of universal gravitation with all its possibilities.

1. Differential equations for planetary motion and Kepler's three laws have been analyzed mathematically.

2. Practical solution of the problem of Moon's motion has been considered.

3. Natural phenomena have been analyzed from the standpoint of physics.

4. The law of universal gravitation has been considered from the dialectical-materialistic standpoint, and everywhere, instead of Newtonian gravity, the oscillatory motion was obtained, i.e., attraction-repulsion, from which there results both the regularity of the whole planetary mechanics and the nature of all aggregation states, from the slow whirling of galaxies to the frenzied flight of an electron. All the so-called "forces" of the material universe – friction, chemical – retaining large particles of matter, elastic – making the body to retain its form, nuclear – making electrons spin wildly around the atomic nucleus, as well as all interactions of bodies are virtually oscillatory motions.

The idea of the existence and superposition of oscillatory motions was developed by D. Bernoulli in his work "*Histoire de l'Académie de Berlin*" (1753), and he came to the idea, which he formulated as follows: "In every system, mutual movements of bodies are always a mixture of simple, regular and persistent oscillations of various kind..."

"The idea of coexistence of small oscillations did not seem to Lagrange entirely clear in all respects, and only later the mathematical research carried out by French scientist Fourier and by a number of scientists made

Lagrange and other physicists consider the core of Bernoulli idea to be beyond any doubt in physics “ (see E. Düring, *Critical History of General Principles of Mechanics*, p. 431).

Thus, oscillatory motions are the universal law encompassing the entire Universe where all forms of motion of matter: motion of Galaxies in the abyss of interstellar space, motion of planets of the solar system, electromagnetic, light, thermal, acoustic, mechanical, and atom-molecule motions are not absolutely related in their physical nature, differ greatly in period length, amplitude and velocity. However, despite this fact, there are always common oscillatory patterns, i.e. the basic laws of oscillations characterizing the state of these systems, and the regularity of variation of these quantities that determine the state of the system for all the above kinds of motion is the same.

This basic form of motion – the oscillatory motion – is the only original form leading to “the unity of the Universe”.

Leaving aside other, perhaps equally important, divergences between the reality and the theory of gravity, we will try to present a true picture of planetary mechanics on the basis of the laws of oscillatory motion according to the data of analytical mechanics observed in everyday life, rather than by using different axioms and alluring fabrications like attractive – pulling force, first divine impulse, absolute rest, uniform motion, curvature of space, etc.

## CHAPTER III

### **CONSTRUCTION OF KEPLERIAN ELLIPSE ON THE BASIS OF THE LAWS OF OSCILLATORY MOTION**

#### **§11. DERRIVATION OF KEPLER'S FIRST AND SECOND LAWS**

In science, it is for some reason believed that the Keplerian ellipse cannot be constructed by addition of oscillatory motions, which means that accelerations (forces) directly proportional to the distance have the center of their motion in the geometric center of the ellipse, and accelerations (forces) inversely proportional to the squared distance – in focus of the ellipse (see E. Dühring, *Critical History of General Principles of Mechanics*, p. 164; R. V. Paul, *Introduction to Mechanics and Acoustics*, p. 51; A. A. Eichenwald, *Theoretical Physics*, p. 137; F. R. Moulton, *Introduction to Celestial Mechanics*, pp. 90-92; M. F. Subbotin, *Course of Celestial Mechanics*, vol. I, p. 27).

In §6 we showed that for all oscillatory motions, including harmonic oscillatory motion, the acceleration is directly proportional to the distance when it is expressed in terms of angular velocity, and inversely proportional to the square of the distance when it is expressed in terms of sector velocity.

Now let us show how by addition of oscillatory motions one can obtain the Keplerian ellipse with all the features for velocity, acceleration, angular and sector velocities, and show that all phenomena observed in celestial mechanics and relevant to planetary motion are obtained as necessary consequences of the addition of oscillatory motions.

To clarify this question, it is necessary to recall the nature of the motion of a planet in long-period variation of the eccentricity and inclination of its orbit to some basic plane.

According to Stockwell, Verrier, etc. tables (see Subbotin, Celestial Mechanics, vol. II, p. 291), the explanation of which is given above (p. 38), we have to imagine (formula 16) that some solid body, for example, a planet, executes a harmonic oscillatory motion

$$x=acos\Omega t \text{ and } y=asin\Omega t$$

and at the same time oscillates in pendulum-like motion.

In order to visually represent the motion pattern, trajectory, velocity, acceleration, angular and sector velocities, we ascribe these motions to the appropriate coordinate system and write the equations of motion of a solid body according to the laws of analytical mechanics (see Suslov, Fundamentals of Analytical Mechanics, vol. I, p. 139; Nicolai, Lectures on Theoretical Mechanics, vol. I, pp. 165-177).

According to the laws of relative motion, let us imagine that the body  $M$  moves simultaneously in two media  $S$  and  $\Sigma$ .

The position of the body  $M$  in the medium  $S$  is defined using a coordinate system with the  $Oxyz$  axes, and in the medium  $\Sigma$  – using the coordinate axes  $A\xi_1\eta_1\zeta_1$ . The medium  $\Sigma$  itself moves in the medium  $S$ .

Let us call the motion of the body  $M$  in the medium  $\Sigma$  relative, and the motion of the environment  $\Sigma$  in the medium  $S$  – translational.

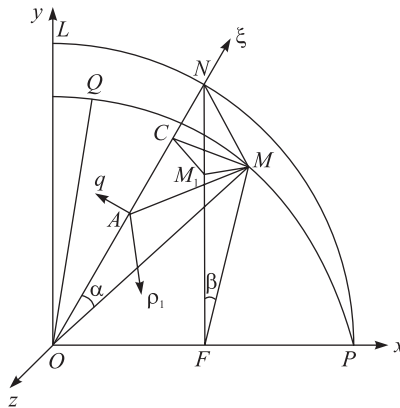


Fig.4

Then the motion of the body  $M$  in the medium  $S$  will be absolute. Denoting the coordinates of the absolute motion by  $x, y, z$ , the coordinates of the translational motion by  $x_A, y_A, z_A$ , and the coordinates of the relative motion by  $\xi_1, \eta_1, \zeta_1$ , the angle formed during the translational motion – by  $E$ , we can write the equation for the motion of the body  $M$  (Fig. 4) in the following form:

For the translational motion

$$OF=x_A=acosE; \quad NF=y_A=asinE; \quad z_A=0 \quad (20)$$

For the relative motion

$$\begin{aligned} AC=\xi_1=AM\cos2\alpha; \quad \eta_1=0; \quad CM=\zeta_1=\frac{a}{2}\sin2\alpha \\ \text{i.e. } \xi_1=\frac{a}{2}\cos2\alpha; \quad \eta_1=0; \quad \zeta_1=\frac{a}{2}\sin2\alpha\dots \end{aligned} \quad (21)$$

where  $ON=A; \quad OA=AN=AM=\frac{a}{2},$

the angle  $NOM=\angle\alpha; \quad \anglePON=\angle E.$

According to formula (20) and Fig. 4, the body rotation occurs in the plane  $xOy$ , i.e. in the plane  $POLNP$  around the axis  $Oz$ , and oscillation of the body occurs in the plane  $NOMN$  according to formula (21).

The basic law of nature – preservation of the pendulum oscillation plane – is that the oscillation plane  $NOMN$  remains perpendicular to a certain plane  $POQMP$  in all its movements.

The plane  $POQMP$  itself is inclined to the plane  $xOy$  of the translational motion at an angle  $\beta$ , i.e.

$$\angle QOL=\angle MFM_1=\angle MFN=\angle\beta=\text{const.} \quad (22)$$

Therefore, the  $NOMN$  plane of the relative motion forms a variable angle  $k$  with the  $POLNP$  plane of the translational motion. The point  $M_1$  is the projection of the point  $M$  on the plane  $xOy$ .

Due to the preservation of the oscillation plane  $NOMN$ , the coordinate axes  $A\xi_1\eta_1\zeta_1$  of the relative motion do not coincide with the coordinate axes  $Oxy$  of the absolute motion. In order to express the coordinates of the relative motion in absolute coordinates, we assign the relative motion from formula

(21) to a new coordinate system  $A\xi_2\eta_2\zeta_2$ , where the axis  $\xi_2$  coincides with the axis  $\xi_1$ ; the axis  $\xi_2$  and the axis  $OZ$  are parallel, the cosines of the angles between the old  $A\xi_1\eta_1\zeta_1$  and the new  $A\xi_2\eta_2\zeta_2$  axes are given by the following scheme, according to Fig. 5.

	$\xi_1$	$\eta_1$	$\zeta_1$
$\xi_2$	1	0	0
$\eta_2$	0	$\sin k$	$-\cos k$
$\zeta_2$	0	$\cos k$	$\sin k$

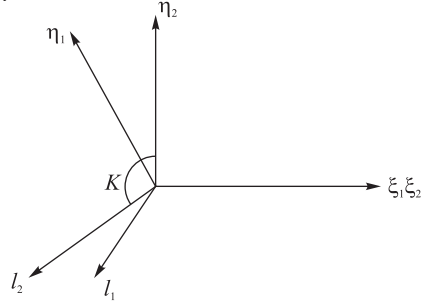


Fig. 5

The transfer from one axis to another occurs according to the formulas:

$$\begin{aligned}\xi_2 &= \xi_1 \cdot 1 + \eta_1 \cdot 0 + \zeta_1 \cdot 0, \\ \eta_2 &= \xi_1 \cdot 0 + \eta_1 \cdot \sin k + \zeta_1 \cdot (-\cos k), \\ \zeta_2 &= \xi_1 \cdot 0 + \eta_1 \cdot \cos k + \zeta_1 \cdot \sin k,\end{aligned}$$

from which we have

$$\xi_2 = \xi_1 = \frac{a}{2} \cos 2\alpha; \quad \eta_2 = -\frac{a}{2} \sin 2\alpha \cos k; \quad \zeta_2 = \frac{a}{2} \sin 2\alpha \sin k.$$

For clarity and convenience let us transfer the origin of coordinates of the relative motion from the point  $A$  to the point  $N$  (Fig.4).

Then the coordinates of the translational motion will be:

$$x_A = a \cos E; \quad y_A = a \sin E; \quad z_A = 0,$$

and the coordinates of the relative motion:

$$\left. \begin{aligned}\xi &= \frac{a}{2} \cos 2\alpha - \frac{a}{2} = -a \sin^2 \alpha \\ \eta &= -\frac{a}{2} \sin 2\alpha \cos k = -a \sin \alpha \cos \alpha \cos k \\ \zeta &= \frac{a}{2} \sin 2\alpha \sin k = a \sin \alpha \cos \alpha \sin k\end{aligned} \right\} \quad (23)$$

Then it is easy to write the relation between the absolute, translational and relative motions by the formula:

$$\left. \begin{aligned} x &= x_A + \xi \lambda_x + \eta \mu_x + \zeta v_x \\ y &= y_A + \xi \lambda_y + \eta \mu_y + \zeta v_y \\ \zeta &= z_A + \xi \lambda_z + \eta \mu_z + \zeta v_z \end{aligned} \right\} \quad (24)$$

where  $\lambda_x; \lambda_y; \dots; \mu_x; v_x; \dots; v_z; x_A, z_A$  are the coordinates of the medium  $\Sigma$  with respect to the medium  $S$ ; the cosines of the angles  $\lambda_x; \dots; v_z$  are given according to the following scheme (see Suslov, Fundamentals of Analytical Mechanics, p.139).

	$\xi$	$\eta$	$\zeta$
$x$	$\lambda_x = \cos E$	$\mu_x = -\sin E$	$v_x = 0$
$y$	$\lambda_y = \sin E$	$\mu_y = \cos E$	$v_y = 0$
$z$	$\lambda_z = 0$	$\mu_z = 0$	$v_z = 1$

Substituting the value

$$\cos k = \frac{\cos E \sin \beta}{\cos \alpha} \quad \text{и} \quad \sin k = \frac{\cos \beta}{\cos \alpha}$$

and bearing in mind that from the right-angled triangle  $NOM$  we have

$$NM^2 = a^2 - R^2 = f^2 \sin^2 E = a^2 \sin^2 \alpha,$$

$$\sin \alpha = e \sin E,$$

we get:

$$\left. \begin{aligned} x &= \{x_A\} + \{x_1\} = \{a \cos E\} + \{0\} \\ y &= \{y_A\} + \{y_1\} = \{a \sin E\} + \{-f \sin \beta \sin E\} \\ z &= \{z_A\} + \{z_1\} = \{0\} + \{f \cos \beta \sin E\} \end{aligned} \right\} \quad (24a)$$

In braces  $\{ \}$  the translational submotions along the coordinate axes  $Ox$ ;  $Oy$ ;  $Oz$  are given, and in square brackets  $[ ]$  – the relative submotions along the same axes.

Here  $a \cos E$  is the translational submotion along the  $x$ -axis;

$a \sin E$  is the relative submotion along the  $y$ -axis;

$-f \sin \beta \sin E = -a \sin \beta \sin \alpha$  is the relative submotion along  
the  $y$ -axis;

$f \cos \beta \sin E = a \cos \beta \sin \alpha$  is the relative submotion along  
the  $x$ -axis.

As is clear, the relative motion does not give a submotion along the  $x$ -axis in the given coordinate system.

Let us find a motion trajectory; for this purpose, we represent formulas (24a) as:

$$\left. \begin{aligned} x &= a \cos E \\ y &= a \sin E - f \sin \beta \sin E = a \cos^2 \beta \sin E \\ z &= a \sin \beta \cos \beta \sin E. \end{aligned} \right\} \quad (25)$$

Then for the trajectory we have

$$\frac{x^2}{a^2} + \frac{y^2}{a^2 \cos^2 \beta} + \frac{z^2}{a^2 \cos^2 \beta} = 1$$

the ellipsoid of rotation about the  $x$ -axis.

The trajectory will have the form of intersection of this ellipsoid with the ellipse plane

$$\frac{x^2}{a^2} + \frac{y^2 + z^2}{a^2 \cos^2 \beta} = 1,$$

i.e. the ellipse.

This is evident from the fact that the relative motion gives no submotion along the  $x$ -axis due to the conservation of the plane  $NOM$ , and therefore, the plane  $NOM$  is always perpendicular to the plane  $POQ$ , i.e. to the trajectory plane. Hence, the trajectory of the body is a projection of the circle  $POL$  onto the plane  $POQ$ , and it is an ellipse.

On the other hand, the absolute motion of the body (formula 24a) assigned to the coordinate system  $Oxyz$  (Fig.4) can be assigned to the new coordinate system  $OXYZ$ , taking the angles of the old and new axes from the given scheme:

	$x$	$y$	$z$
$X$	1	0	0
$Y$	0	$\cos \beta$	$\sin \beta$
$Z$	0	$-\sin \beta$	$\cos \beta$

Passing from one axes to another, we get

$$X=x; \quad Y=y \cos \beta + z \sin \beta; \quad Z=-y \sin \beta + z \cos \beta.$$

Substituting the values  $x, y, z$  from equation (24a), we get



$$\begin{aligned} X &= \cos E, \\ Y &= b \sin E, \\ Z &= 0. \end{aligned}$$

Hence, we obtain an ellipse in the coordinate system  $OXYZ$ .

Thus, Kepler's first law that planets describe an ellipse is confirmed to a high degree of mathematical accuracy by addition of the oscillatory motions: angular (formula 20) about a certain axis and pendulum-like oscillatory (formula 21).

It is impossible and will never be possible to obtain to a high degree of mathematical accuracy an ellipse by addition of rectilinear motion directed to the center due to the attraction of the Sun and the inertial rectilinear uniform motion, because these motions are not real, they do not exist, and they are a product of our metaphysical thinking (see above, §3).

Geometrical derivation

The translational motion (Fig. 4):

$$\begin{aligned} x_A &= OF = a \cos E, \\ y_A &= NF = a \sin E, \\ z_A &= 0. \end{aligned}$$

The relative motion:

$$\xi = AC = \frac{a}{2} \cos 2\alpha; \quad \eta = 0; \quad \zeta = \frac{a}{2} \sin 2\alpha,$$

where

$$A = OP = ON; \quad \angle E = \angle PON; \quad \angle \alpha = \angle NOM; \quad \angle \beta = \angle MFN.$$

The rotation of the body occurs in the plane  $xOy$ , whereas the pendulum-like oscillation – in the plane  $NOM$ , the direction of which is retained.

The absolute motion coordinates will be (Fig.4, formula 25)

$$\begin{aligned} x &= OF = \{x_A\} = \{a \cos E\}; \\ y &= M_1F = \{NF\} - \{NM_1\} = \{a \sin E\} - \{NM \cos(90 - \beta)\} = \\ &= \{a \sin E\} - [a \sin^2 \beta \sin E] = a \cos^2 \beta \sin E; \\ z &= (0) + [M_1M] = [NM \cos \beta] = a \sin \beta \cos \beta \sin E. \end{aligned}$$

In braces { } the relative submotions along the coordinate axes  $Ox$ ,  $Oy$ ,  $Oz$  are given, and in square brackets [ ] – the relative submotions along the same axes.

Let us find sector velocities about the axes  $Ox$ ,  $Oy$ ,  $Oz$  (see Suslov, Fundamentals of Analytical Mechanics, vol.1, p. 30):

$$\left. \begin{aligned} 2S_x &= yz' - zy' = 0 \\ 2S_y &= zx' - xz' = -a^2 \sin\beta \cos\beta E' \\ 2S_z &= xy' - yx' = a^2 \cos^2\beta E' \end{aligned} \right\} \quad (26)$$

Multiplying  $S_x$ ,  $S_y$ ,  $S_z$  respectively by  $x$ ,  $y$ ,  $z$  and adding them, we get:

$$S_x x + S_y y + S_z z = 0 \quad (27)$$

This relationship shows that the motion of the body takes place in the plane that passes through the origin of coordinates, i.e. through the point  $O$ . This conclusion also follows from the fact that the sector velocity  $S$  about the axis  $Ox$  is zero, i.e. the body moves in the plane perpendicular to the plane  $ZOY$ .

The intersection of the plane  $S_x x + S_y y + S_z z = 0$  of the ellipsoid of revolution about the axis  $a$ :

$$\frac{x^2}{a^2} + \frac{y^2}{a^2 \cos^2\beta} + \frac{z^2}{a^2 \cos^2\beta} = 1$$

will be the trajectory of the body. It will be ellipse.

Let us find the inclination of this ellipse plane to the plane  $xOy$ , i.e. the normal of this plane with the axis  $Oz$  forms the angle  $i$

$$\cos i = \frac{2S_z}{\sqrt{4S_x^2 + 4S_y^2 + 4S_z^2}} = \cos\beta \quad (28)$$

i.e. the eccentricity angle  $\beta = \arcsin i$  is the inclination of the planetary orbit from the Laplace plane.

Hence, the plane of the body trajectory (ellipse) is inclined to the  $xOy$  at an angle  $\beta = \angle MFN$ , then the axes of the ellipse will be:

$$b = a \cos\beta; \quad a^2 - b^2 = f^2; \quad f = ae; \quad e = \sin\beta.$$

The body will have the highest sector velocity around the normal to the trajectory plane, i.e. around the axis passing through the geometrical center of the ellipse. The value of this maximum sector velocity is:

$$2S = \sqrt{(2S_x)^2 + (2S_y)^2 + (2S_z)^2} = E'ab \quad (29)$$

(see Suslov, Fundamentals of Analytical Mechanics, vol. I, part II, p.40).

Let us define the sector velocity about the axis parallel to the normal of the trajectory plane, but passing through the focus. In other words, transfer the origin from the geometric center to the focus. Then the coordinates of the absolute motion and sector velocities about the axes will be:

$$\left. \begin{aligned} x &= a \cos E - f; & y &= a \cos^2 \beta \sin E; & z &= a \sin \beta \cos E; \\ 2S_{1x} &= yz' - zy' = 0 \\ 2S_{1y} &= zx' - xz' = -\sin \beta [E'ab - E'fbcosE] \\ 2S_{1z} &= xy' - yx' = \cos \beta [E'ab - E'fbcosE] \end{aligned} \right\} \quad (30)$$

Then the sector velocity about the axis passing through the focus to the trajectory plane (i.e. to the orbit plane) will be

$$2S_1 = \sqrt{(2S_{1x})^2 + (2S_{1y})^2 + (2S_{1z})^2} = ab(E' - E'e \cos E). \quad (31)$$

Let us impart the expression  $E' - E'e \cos E$  a physical meaning.

According to our designation,  $E$  is the angle formed during the translational motion and referred in celestial mechanics to as the “eccentric anomaly”.

Then  $E$  is the angular velocity of the translational motion which, following the laws of mechanics, is equal to the vector sum of the angular velocity of the harmonic oscillatory motion  $\Omega$  plus the angular velocity of the relative motion  $E'e \cos E$

$$E' = \Omega + E'e \cos E, \quad (32)$$

from which  $E' - E'e \cos E = \Omega$ ; this angular velocity is referred in astronomy to as the daily mean motion and is denoted by the letter  $n$ .

Thus, in the absence of perturbing forces, i.e. pendulum-like motion, the planet in the invariable plane executes a harmonic oscillatory motion (circular motion) with the angular velocity  $\Omega = n$ .

This conclusion agrees with the data of celestial mechanics:

“If the perturbation function  $R$  included in the equation is equal to zero, then we have the case of unperturbed motion that takes place in the variable plane” (see Subbotin, Course of Celestial Mechanics, vol. II, p. 20).

“If the body does not execute a relative motion with respect to the medium, then its translational motion coincides with the absolute motion” (see W. L. Nicolai, Lectures on Theoretical Mechanics, vol. I, p. 116).

Integrating this equation, we get the well-known Kepler’s equation

$$E - e \sin E - \Omega(t - T) = n(t - T) = M,$$

where  $T$  is the constant of integration.

In astronomy, the angle  $M(\Omega = t - T)$  is called the mean anomaly and is denoted by  $M$ .

Multiplying the last equation by the ellipse semi-axes  $a$  and  $b$ , we get the areas described by the radius-vector of the planet (Fig.6):

$$Eab - fb \sin E = \Omega(t - T)ab = n(t - T)ab = 2k(t - T). \quad (33)$$

With this definition introduced by Hipparchus as far back as the second century BC and preserved in all astronomic expressions for all orbital motions up to now, we can conclude that the sector velocity of the planet around the focus

$$2k = \Omega ab = E'ab - E'fb \cos E = \text{const} \quad (34)$$

is the constant, which is typical for the Keplerian ellipse.

In astronomy, a physical meaning is given to the expression  $E' - E'e \cos E$  artificially.

To do this, they imagine a fictitious planet, which moves in a circle with radius  $a$  (the semi-major axis of the ellipse) with constant angular velocity  $n$  (see Duboshin, Celestial Mechanics, p. 97).

Then the expression  $E' - E'e \cos E$  or  $E - e \sin E = M$  can be represented on the plane of the circle as an angle formed by the radius-vector of this fictitious planet directed to the perihelion.

Since for  $E=0$ ,  $M=0$ , for  $E=180^\circ$ ,  $M=180^\circ$ , and in general, for  $E=k\pi$ ,  $M=k\pi$ , the fictitious planet passes through the perihelion and the aphelion simultaneously with the actual planet and makes one complete revolution in time  $T$ . The angle  $M=nt$  is called the mean anomaly and

$$E' - E'e \cos E = n \quad (34a)$$

is referred to as the daily mean motion (see Subbotin, Celestial Mechanics, vol.I, p.40; Duboshin, Celestial Mechanics, p.97).

Fig. 6 shows that the arc

$$\cup PN = \angle E = PON; \cup Nk = e \sin E = \sin \alpha; \cup Pk = n(t - T) = M.$$

On the average, the arc  $M$  is the same for equal time intervals and therefore is called the mean anomaly and is equal to  $M = n(t - T)$ , where  $n$  is the daily mean motion for the given epoch. The equation  $E - e \sin E = M = n(t - T)$  is called Kepler's equation and is used to determine  $E$  for the given instant of time  $t$ .

The equation  $E - e \sin E$  is transcendental when  $M$  and  $E$  are expressed in degrees, and  $e$  must also be expressed in degrees:  $e^0 = 57^0,29578e$ , and all this can be expressed inversely in radians.

In formula (34),  $2k$  is the double sector velocity around the focus (see Fig.6), where

$$\angle PON = E; \quad OF = f;$$

$$OP = A; \quad OQ = b;$$

$nab(t - T)$  is the area  $2MFP = 2kt$ , described by the radius-vector around the focus in time  $\tau = (t - T)$ ;  $ab$  is the area  $2OMP$ ;  $f b \sin E$  is the area  $2OMF$ ;

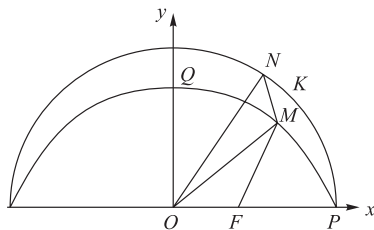


Fig. 6

The constancy of the sector velocity  $2k$  around the focus

$$2k = r^2 \varphi'$$

can also be derived from the momentum conservation law for the given free system (see Grimsel, Physics, vol. I, p.132; Papalex, Physics, vol. I, p.128):

$$J\varphi' = \text{const},$$

where  $J$  is the moment of inertia,  $\varphi'$  is the angular velocity.

Substituting the value of the moment of inertia  $J = mr^2$ , we can write

$$r^2 \varphi' = \text{const}.$$

The constancy of the sector velocity can also be obtained from the differential equations  $x'' + \frac{m^2}{r^3}x = 0$  and  $y'' + \frac{m^2}{r^3}y = 0$  by the relevant transformation, and thereby we obtain  $xy' - yx' = r^2 \varphi' = C = \text{const}$ , where  $C$  is the constant of integration.

## §12. PLANET VELOCITY AND ACCELERATION

Now let us define planet velocity and acceleration values. Differentiating formulas (24) with respect to time, we get:

$$\left. \begin{aligned} x' &= \{x'_A + \xi\lambda'_x + \eta\mu'_x + \zeta v'_x\} + [\xi\lambda_x + \eta\mu_x + \zeta v_x] \\ y' &= \{y'_A + \xi\lambda'_y + \eta\mu'_y + \zeta v'_y\} + [\xi\lambda_y + \eta\mu_y + \zeta v_y] \\ z' &= \{z'_A + \xi\lambda'_z + \eta\mu'_z + \zeta v'_z\} + [\xi\lambda_z + \eta\mu_z + \zeta v_z] \end{aligned} \right\} \quad (35)$$

(see G. Suslov, Fundamentals of Analytical Mechanics, vol. I, p. 141).

Substituting the corresponding values, we get:

$$\begin{aligned} x' &= \{-aE' \sin E \cos^2 \beta\} + [-f \sin \beta E' \sin E] = -aE' \sin E; \\ y' &= \{aE' \cos E\} + [-f \sin \beta E' \cos E] = a \cos^2 \beta E' \cos E; \\ z' &= \{0\} + [f \cos \beta E' \cos E] = a \sin \beta \cos \beta E' \cos E. \end{aligned}$$

The expressions in braces are the transport velocity, and those in square brackets – the relative velocity.

$$v^2 = (x')^2 + (y')^2 + (z')^2 = \{E'a\}^2 - [E'f \cos E]^2 = E'^2 r_1 r_2$$

or in the vector form

$$\vec{v} = \overrightarrow{E'a} - \overrightarrow{E'f \cos E}.$$

Thus, the absolute velocity is equal to the vector sum of the transport and relative velocities.

The same holds for acceleration. Differentiating formulas (35) with respect to time, we get:

$$\begin{aligned} x'' &= \{x''_A + \xi\lambda''_x + \eta\mu''_x + \zeta v''_x\} + [\xi''\lambda_x + \eta''\mu_x + \zeta''v_x] + 2(\xi'\lambda'_x + \eta'\mu'_x + \zeta'v'_x); \\ y'' &= \{y''_A + \xi\lambda''_y + \eta\mu''_y + \zeta v''_y\} + [\xi''\lambda_y + \eta''\mu_y + \zeta''v_y] + 2(\xi'\lambda'_y + \eta'\mu'_y + \zeta'v'_y); \\ z'' &= \{z''_A + \xi\lambda''_z + \eta\mu''_z + \zeta v''_z\} + [\xi''\lambda_z + \eta''\mu_z + \zeta''v_z] + 2(\xi'\lambda'_z + \eta'\mu'_z + \zeta'v'_z). \end{aligned}$$

(see G. Suslov, Fundamentals of Analytical Mechanics, p. 142).

Substituting the corresponding values, we get:

$$\begin{aligned} x'' &= \{-a \cos^2 \beta E'' \sin E - aE'^2 \cos E\} + [-f \sin E'' \sin E - 2f \sin' E'^2 \cos E] + \\ &\quad + 2(f \sin' E'^2 \cos E); \\ y'' &= \{aE'' \cos E - a \cos^2 E'^2 \sin E\} + [-f \sin' E'' \cos E + 2f \sin' E'^2 \sin E] - \\ &\quad - 2(f \sin' E'^2 \sin E); \\ z'' &= \{0\} + [f \cos' E'' \cos E - f \cos' E'^2 \sin E] + 2(0). \end{aligned}$$

Here, the expressions in braces are the components of translational acceleration, those in square brackets – the components of relative accel-

eration, and in parenthesis – the Coriolis acceleration (see Suslov, Fundamentals of Analytical Mechanics, p.143).

Making a corresponding reduction, we can write:

$$\begin{aligned}x'' &= -a(E'' \sin E + E'^2 \cos E); \\y'' &= a \cos^2 \beta (E'' \cos E - E'^2 \sin E); \\z'' &= a \sin \beta \cos \beta (E'' \cos E - E'^2 \sin E).\end{aligned}$$

Then we get for the acceleration

$$\begin{aligned}G &= (x'')^2 + (y'')^2 + (z'')^2 = (E''^2 a^2) + (E'^2 a)^2 - [(E'' f \cos E)^2 + \\&+ (E'^2 f \sin E)^2 - 2E'' E'^2 f \sin E \cos E]\end{aligned}$$

and finally

$$G = -E'^2 a.$$

### §13. DERRIVATION OF KEPLER'S THIRD LAW

As is known from theoretical mechanics, the total energy of the Keplerian motion will be written as (see formula 15)

$$E = -\mu^2 \frac{m}{2a} = \frac{1}{2} m v^2 = \mu^2 \frac{m}{r}$$

(see Eichenwald, Theoretical Physics, part II, p. 67-70).

Hence we get

$$v^2 a \frac{r_1}{r_2} = \mu^2$$

( $r_1$  and  $r_2$  are the ellipse radius-vectors) a usual expression for the planet velocity (see Subbotin, Celestial Mechanics, p.37, and Buhholz, Theoretical Mechanics, p. 300).

But, according to formula (5),

$$v^2 = E'^2 r_1 r_2 = n^2 \frac{a^2}{r_j^2} r_1 r_2$$

and thus

$$v^2 a \frac{r_1}{r_2} = n^2 a^3 = \mu^2.$$

The expression  $n^2 a^2$  is a true meaning of Kepler's third law (where  $n$  is the daily mean motion, and

$$\mu^2 = \frac{4k^2}{b^1} a = \text{const}$$

for all planets.

This conclusion about Kepler's third law can easily be obtained from the oscillatory motion property in the more accurate and acceptable form.

From the differential equations for planetary motion (formulas 2 and 2a) we have

$$\omega^2 = \frac{m^2}{r^3} = n^2 \frac{1}{(1 - \cos E)^3},$$

from which

$$\omega^2 r^3 = n^2 a^3 = \mu^2,$$

where  $\omega$  is the circular natural frequency of the oscillatory system (see S. P. Strelkov, Introduction to Theory of Oscillations, pp. 17-22).

Thus, for the superposition of oscillatory motions – one translational motion (formula 8),

$$x_A = a \cos E; \quad y = a \sin E; \quad Z_A = 0$$

and the other – relative motion (formula 10)

$$\xi = \frac{a}{2} \cos 2\alpha; \quad \eta = 0; \quad \zeta = \frac{a}{2} \sin 2\alpha,$$

with real participation of the planet, we get the absolute planet motion:

$$\begin{aligned} x &= a \cos E \\ y &= a \cos^2 \beta \sin E \\ z &= a \sin \beta \cos \beta \sin E, \end{aligned}$$

from which not only Kepler's three laws are obtained in strict mathematical sequence, but also all the properties of planetary motions and in the most simple and convincing form.

As we see, the opinion well established in science that the Keplerian motion cannot be obtained from oscillatory motions, is incorrect.

All natural phenomena, including the motion of the planets of the solar system obey only oscillatory periodic motions.

Decomposition of the Keplerian ellipse into two motions lying in the same plane: attraction to the Sun and the inertial motion (according to the basic conception of the Newtonian principles which consists in the representation of the motion of the Moon and planets as a consequence



of the geometrical addition of two forces: 1) force of inertia (the initial impulse) and 2) the force of gravity directed towards the center), as well as the construction of these two motions is not possible without forcing oneself, and all attempts in this direction have always failed and will fail completely, since Newtonian gravity is an example of metaphysical thinking. And there is no doubt that such a metaphysical way of thinking to which we have been accustomed for over 300 years, undoubtedly brings up people – fanatics of science who, despite all their knowledge, accept as truth and are ready to hold on to the “truth” that satisfies them today.

Lorenz is right, when he says: “... there is no doubt that the tendency to one or another understanding depends on the way of thinking to which we are accustomed”.

In this case, important is not the fact that not all the properties, not all the questions of celestial mechanics and physics are solved here, but the idea itself, as a principle, as well as the laws connecting the fundamental properties of planetary motion in the solar system with the properties of oscillatory motions.

There is a common pattern and a particular correspondence between the above characteristic properties and oscillatory motions and between the observed properties of planetary motion in the solar system, which reveal the structure of the solar system as a continuous approach of one body to another and their continuous separation from each other.

This correspondence expresses readily the idea that the natural reason for the periodic recurrence of properties of motion of planets and comets of the solar system are the properties of oscillatory motion being repeated periodically with the same regularity.

Thus, the observed regular correspondence between the motion of planets of the solar system and the oscillatory motions will become the starting point for the solution and explanation of the possible properties of planetary motions (figures of conic sections of planetary orbits, true orbits, periodicity of revolution, constancy of the sector velocity, relationship of the period of revolution with the semi-major axis of the planets, rotation of line of apses, stability of the system, inclination of the orbit, Bode series,

etc.) that have not been solved yet and cannot be explained by gravitation and inertia, but can easily be explained by the laws of oscillatory motion and not only explained but, as we have seen, are derived as necessary consequences of these motions.

The idea of this connection of oscillatory motions with the motions of celestial bodies forms the basis of a new doctrine, essentially a dialectical concept of planetary motion in the solar system and, generally, of any free motion.

All the above determines the content and the direction of our research.

## CONCLUSION

Based on the aforementioned proof, we must state:

1. It is necessary to abandon the Newtonian notion of the “force of universal gravitation” which is not confirmed either by mathematical derivations or by experimental data and is inconsistent with the teaching of dialectical materialism.

This “force” is invented by us and imposed upon nature from outside, and therefore, it stands apart among all the physical natural phenomena and in the whole system of physical theories, binding the science for over three hundred years.

2. The motion of planets of the solar system is based on the principle of attraction-repulsion, i.e. the principle of oscillatory motion the equations of which govern not only the planetary mechanics and the motion of galaxies in the abyss of interstellar space, but all nuclear, electromagnetic, light, thermal, and acoustic processes, all interactions of bodies on the terrestrial and extraterrestrial surface, and the same equations of oscillatory motion can combine classical physics with quantum physics and gain deeper insight into the structure of elementary particles of the atom.

This statement is also supported by the fact that expressing the bases of the Universe – gravity and electromagnetism by the same mathematical equations of the oscillatory motions, we introduce to the science the unity

of understanding of all physical phenomena, i.e. “the unity of the Universe”, where separate qualitatively different forms of motion of matter are always subject to the laws of oscillatory motion and, under certain conditions, always pass in certain ratios into one another.

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PART II

**ON UNIFORM MOTION**





## INTRODUCTION

I think that the expression of cautious doubt cannot reduce either the virtue, or the entertaining character of scientific issues.

“Any body, left by itself, remains at rest or continues to move linearly and uniformly, until some external cause will not change this state” (I. Newton. “Mathematical Principles of Natural Philosophy”, transl. by Krylov, 1936) [1].

Mathematically it can be expressed as

$$\frac{ds}{dt} = v = \text{const} \quad (\text{A})$$

where  $v$  is the motion velocity.

Any body left by itself retains a constant velocity (in magnitude and direction).

Differentiating the expression (A), we get  $\frac{d^2s}{dt^2} = \frac{ds}{dt} = 0$ , i.e. the acceleration is zero.

Integrating the expression (a) between 0 and  $t$ , we have:

$$s = vt$$

i.e. the formulas for the path of uniform motion.

## §1. MOTION AND REST

We will not touch upon the question of “rest”, since “rest” as such is void of any sense. Every rest and balance have only a relative value and are special cases of motion. Since matter exists, its existence is expressed in motion, i.e. there is a perpetual transition from one form of motion into another. Motion is an attribute immanently inherent to the body. It is impossible to consider matter and motion separately.

### **Motion is the form of the existence of matter.**

Now all physicists recognize implicitly that matter absolutely at rest is nonsense. Even a body that is relatively at rest has a huge reserve of energy, a huge storage of motion. Therefore, the motion of matter is inherent in it, there are no external sources of motion, and the source of the motion of matter is the notion of matter itself.

And what is uniform motion?

Is it acceptable from the viewpoint of motion in general, from the viewpoint of modern physics? After all, the word motion must be understood not as a simple movement of the body in space, not as a simple change of one place to another, but as **a movement associated with changes in general, with the development of motion, both quantitatively and qualitatively.**

Ancient philosophers, materialists regarded motion not only as a change in the body position, i.e. a movement, but as all the changes, the object of which is the given body, including qualitative changes and even a physical change, i.e. the appearance of a different body, as such.

From the XVII century, after Galileo-Newton, by introducing into science the doctrine of the absolute immutability of nature without any influence of external forces, motion was regarded as a mechanical motion, i.e. a simple movement. According to Newton, motion is a modus that matter may not possess.

The inner content of the process of motion is a struggle of opposites, which manifests itself in the form of interaction of opposites.

Every phenomenon in nature contains a contradiction and is a unity of the opposing sides, this inconsistency is also inherent in motion in all its forms. In the case of a relatively simple form of motion – spatial motion – this inconsistency must also show up.

The question is, what changes, what develops, what struggle of opposites and what inconsistencies are there in uniform motion?

Uniform motion is a special case of rest, and vice versa, it is a spatial position of a body. What does it give in the sense of a change and development of motion in general?

On the basis of Newton's laws, we state that the body moves uniformly if it changes its position defined by the coordinates of the body, referred to any coordinate system:

And what are these coordinates?

This is a variable coordinate – time coordinate calculated from the nonexistent coordinate system, because if there is a basic coordinate system and a process for time keeping, then, according to Newton's laws, uniform rectilinear motion can in no way exist.

In addition, the existence of the basic coordinate system determines the existence of the “absolute rest”.

In fact, here is the insurmountable difficulty of Newtonian mechanics: as soon as we connect the coordinate system with the Earth or the Sun, etc., only under this condition, Newtonian mechanics will acquire a physical meaning, but the basic premise of the law of inertia – “free from external influences” will be immediately violated, since according to the same laws of Newtonian mechanics, there should occur attractive forces acting on one another other. Therefore, Newton had to introduce a “famous” absolute space, which affects the whole classical Newtonian mechanics.

Without the concepts of absolute space and absolute time, Newton's law of inertia would not have any sense; but these concepts, as is well known, cannot be attributed to the “reality” in the physical sense of the word.

In fact, we observe the motion of bodies relative to each other – the relative motion, and as we see, the relative motion can never be uniform.

Uniform motion is a notion obtained by means of abstraction – mental experience, that is a fiction, and there is no sense to speak of uniform motion of a free body in space; therefore, according to the laws of dialectics, oscillatory motion, i.e. attraction-repulsion, approach- separation, contraction-expansion, rather than uniform motion, should be regarded as the basic form of any motion.

Nature, for which the law and the essence are unity and simplicity, cannot contain in itself “the special essence, the special force” for each phenomenon.

In nature, there must be a common fact – the fact that is the basis for all phenomena both of organic and inorganic life.

This eternal – general motion is precisely an oscillatory motion, the simplest form of matter in motion.

Thus, expressing physical concepts in the form of objective properties of moving matter both from quantitative and qualitative viewpoint, we have to consider the concept of “motion” – as a periodic oscillatory motion.

Uniform motion, or motion lasting indefinitely with constant velocity should be considered as once occurred, and accordingly someday subject to termination. At first, Galileo considered any velocity as something resulting from the addition of elementary velocities, or from the relevant decomposition.

Thus the principle of everlasting motion with constant velocity is a process, paradoxicality of which for a long time (from Archimedes to Galileo) impeded its discovery and the establishment of the metaphysical principle continued in science from Galileo to Newton, and this process was not very easy at all.

This metaphysical concept, the phenomenon that is never observed – the uniform motion, when the body is not under the action of any external forces, was put by the law of inertia in the first place among the basic concepts of Newtonian mechanics, whereas the fact that all bodies fall with the same acceleration established by the reliable observations, finds no place in the foundations of classical Newtonian mechanics.

The principle of uniform motion, accepted today as a physical fact, which, despite its simplicity, is as if extracted from the natural phenomena by decomposition of complex natural processes, but cannot be regarded as a pure necessity of our thinking. Therefore, in Galileo’s methods of consideration, this principle finds no support, although in the Galilean methods of investigation there is no lack of speculative elements.

## §2. CENTER-OF-GRAVITY MOTION

The principle of uniform motion leads directly to the idea of creation and hence of destruction of motion, i.e. leads to the first impulse. And in fact, we consider this issue in such notions which, according to Newtonian mechanics, have no special reason to be either misunderstood or differently interpreted.

These concepts include quite a clear and definite theorem for center-of-gravity motion, or, as is known in mechanics, for conservation of center-of-gravity motion.

Newton in his brilliant essay “Mathematical Principles of Natural Philosophy (Corollary 4 to the axiom and preliminaries) proves the theorem that the inertia of the center of gravity of the system of bodies does not change its state under mutual actions of bodies upon one another, i.e. the center of gravity of the system has such properties as if all the masses were concentrated in it.

The beginnings of this theory can be found in Galileo’s works, but it was perfectly developed by Lagrange. “When several bodies are moving around a fixed center, the sum of products of the mass of each body by its velocity of rotation around the center and by its distance from the center is always independent of the mutual action which the bodies can produce on one another, and must always remain unchanged unless there is some external action or obstacle”. (LaGrange. *Analytical Mechanics*, vol. I, p. 317).

This theorem implies that all internal forces, must be imagined as acting between any two bodies, according to Newton’s third law, as the forces equal and oppositely directed, and their resultant is equal to zero, i.e. is balanced; then the state of motion of the center of gravity depends solely on the action of external forces.

If external forces do not act on the system, the center of gravity may either maintain rest, or move in rectilinear uniform motion, i.e. move according to the law of inertia.

The shell discharged from the gun describes a certain trajectory in space: when this shell explodes in space, the center of gravity of the shell

system will move along the trajectory, along which the shell would have moved without any explosion.

The center of gravity of the system of two or more bodies does not change its state whether of rest or of motion under the action of the bodies upon one another.

If we consider nature in general, as a whole system, it cannot contain any external forces, i.e. no forces that could be originated outside nature; thus for the whole system – nature – the possibility of occurrence of external forces is eliminated.

But if in addition to the present motion of external forces we exclude the previous ones and their completed action, the possibility of inertial motion can also be eliminated.

“In other words, for nature as a whole, as a system that can be regarded as completely isolated and self-sufficing with respect to the present and the past, the possibility of inertial motion of the center of gravity and hence movement in space is definitely eliminated” (E. Dühring: “Critical History of the General Principles of Mechanics,” pp. 233-236).

Thus, we have come to a situation that in nature as such, there is a point at rest – the center of gravity of the whole system at rest, and to set it in motion, according to Engels’ correct comment, “the first impulse” was necessary.

Therefore, if there is a uniform motion, the necessary prerequisite of such motion is “the point absolutely at rest” – the center of gravity of the whole system and the first impulse to set this point in motion.

So, who seeks the cause of motion, i.e. sets oneself the aim to clarify the cause of motion of matter in the Universe, or in other words, who seeks the force driving the revolving worlds, balancing the action of gravity, should find the cause of that single impulse which could have taken place formerly, in the first instants of development of world systems.

To solve this very difficult problem, many hypotheses have been proposed, but in most cases by persons unintelligent in other related disciplines and having no lucidity of logical mind required for such mental operation.

The disciples of the ancient Ionian School, Dulles, Anaximander and others, guided by the conclusions of ancient philosophers, often put forward and solved the basic principles of world creation and formulated them by clear logical conclusions, such as the statement formulated by Anaximander:

“The emergence is impossible after infinitely long steady state as is impossible the infinitely long stable state after destruction, and therefore we have to think about the infinite periodic change of emergence and destruction.”

The conception of Anaximander is indisputably demonstrated to us by the present, and fortunately, cannot be refuted by any philosophy: the eternity of time is as far behind us, as far we can assume it ahead.

Consequently, the state of absolute rest would dominate even now. But since this is not the case, we can state with certainty that in the future times as ever can be imagined, processes of periodical changes of emergence and destruction will never end, being transferred from system to system, from universe to universe.

And these are processes of periodical change of emergence and destruction, all cycles of matter in which the latter alternately scatters and compresses because the world is governed by the laws of periodic oscillatory motions.

Even such thinkers as Kant, Laplace, Hegel and others failed to create hypotheses of world creation that could be accepted with allowance for modern astronomical knowledge, and only the followers of dialectical materialism which was gradually developed from Leucippus and Democritus to Marx and Engels can bring some clarity to this question, determining that any being is a motion, and that the basic form of motion is attraction – repulsion, contraction – expansion, i.e. oscillatory motion, and these processes should be regarded not as a force, but as the simplest forms of matter in motion.

Therefore, hereinafter we will not introduce new hypotheses guided by the belief that motion is not a property, but a form of existence of matter, and will not ascribe to matter any external forces setting it in motion

describing different trajectories, and will not consider as an external force the strive of matter to the center of the oscillating system obeying all the laws of oscillatory motions.

The superposition of these motions gives a trajectory of a certain form referred to a particular frame of reference, or a special phenomenon of motion, a highly interesting ability of diversion that can manifest its activity in our spatial representations.

When studying these processes, the ancients had no lack of speculative elements, and according to the ideas of ancient Egyptian, Assyrian-Babylonian scholars, including philosopher-traveler Pythagoras and Democritus – the encyclopedic intellect of Greece, all so-called forces of the material universe, i.e. all interactions of bodies describing different trajectories are generally internal vibrations in nature, in other words, are, according to D. Bernoulli: “a mixture of various simple and regular persistent oscillations.”

This is one simple universal cause generating the force responsible for gravity and motion, light and heat, electricity and sound, and for all other physical phenomena of nature.

These internal vibrations were used by Pythagoras to explain how in the Egyptian sacraments – Memnon statue, sunlight is combined with sound to produce well-known tunes. [19]

Even Newton’s equations of planetary motion are the equations of oscillatory motion [247] and Newton, under the pressure of his epoch, fearing persecution of the Church and the papacy, kept the principle of “attraction”, but gave the dialectically inherent part – “repulsion”- up to the creator of the Universe in the form of the first impulse.

Similarly, Einstein’s planetary motion equations are reduced to the equations of spherical pendulum, i.e. to the equations of oscillatory motion, and if the Ptolemaic theory of planetary motion in differentials and epicycles, which lasted 1600 years and was able to satisfy the scientists of the ancient world who had no lack of speculative elements, is expressed in mathematical terms by using modern means of mathematical analysis, we will come to the same equations of oscillatory motion with all their regularities, which is actually observed.



In science, the established opinion that it is impossible to obtain a Keplerian ellipse from oscillatory motions is wrong; I have proved that all Kepler's three kinematic laws, obtained by observing planetary motion, are derived solely as a necessary consequence of oscillatory motions [72<sup>7</sup>].

Thus, laying motion of matter in time and in space in the basis of world outlook, we must abandon the controversial notions such as "uniform motion", "absolute rest", "force of gravity", "inertia", etc.

These controversial concepts are often found in Newtonian mechanics because Newton's principles laid in the basis of motion of matter, endow the matter with clearly contradictory properties, not consistent with physical reality and incomprehensible from the dialectical standpoint of "motion of matter."

This is the principle of inactivity of matter in which two bodies do not tend to each other, but maintain stubbornly the state of rest, and the principle of attraction by which two bodies tend persistently to each other. Gravitation directly contradicts the law of inertia, and indeed, to regard matter, on the one hand, as inert, and, on the other hand, as having the ability to attract – are two things incompatible with each other.

### **§3. UNITY OF OPPOSITES AND UNIFORM MOTION**

In modern physics, it is impossible to imagine any physical process, and not only a physical process, but also a natural phenomenon, both in the organic and inorganic world, which would not be characterized by the presence of internal contradiction.

This is a basic law of nature – "unity of opposites", and in different "branches" of science is formulated in relation to the form of the ongoing process. In physics and chemistry, this law is expressed by Le Chatelier's principle, but for special cases – by Lenz rule, by Van't Hoff's law, etc. For example, in mechanical processes, with increasing velocity there occurs an inhibitory effect which tends to impede the changes in the initial

process, i.e. the velocity increase, and we take it as an increase in the inertial mass of the body.

Similar to these processes, with increasing body temperature i.e. with increasing velocity of molecules, there occur some phenomena that hinder the change in the velocity of molecules which we take as an increase in the specific heat of a substance.

In much the same manner, with any increase in the electron velocity, there is an inhibitory effect which tends to impede the change in the initial state, i.e. the increase in the velocity of the electron, and we take it as an increase in the electromagnetic mass of the electron.

In general: the process of change of the kinetic energy of matter counteracts the increase in the peculiar inertness of matter, both for mechanical, thermal and chemical processes and for electromagnetic and nuclear processes.

When the process takes place, when the process develops, in the most initial process, there must occur a process that will tend by its action to interfere with the development of the initial process, i.e. to destroy the initial process.

Otherwise, a natural, equilibrium picture of the world would be impossible.

Every primary process would be intensified even further due to the consequent secondary process, until finally both processes would completely break the harmony of the world.

Hence, any process should be characterized by the occurrence of a counteractive process, such as:

Stretch quickly the wire – the wire cools down, the wire is compressed by cooling.

Stretch quickly the rubber tube (rubber in general) – the rubber is heated – the rubber is compressed by heating.

Compress the gas under the piston by fast movement, the gas heats up, – gas expands by heating.

Let the gas expand by quick movement of the piston, the gas is cooled down – the gas is compressed by cooling.

With rapid switching off the current, the brightness of the light bulb is enhanced up to the point that in case of the presence of inductive coils somewhere in the circuit, the lamp burns out; in the same manner, by rapid turning off the gas burner, steam separation of the boiling water increases.

So, in any process there occurs a counteracting process. Similarly, in attraction there occurs a counteracting process – repulsion.

Without this contradictoriness no process and consequently no equilibrium state of the solar system or at least no mechanical motion is possible.

**“The world is driven by a contradiction”,** said Hegel.

But, as we know, nothing like this happens during uniform motion, and what is even worse, during the motion caused by gravity, where with increasing velocity the acceleration should allegedly grow (according to Newton).

The simultaneous increase in velocity and acceleration must naturally disturb the equilibrium pattern of motion of the whole solar system, the system of the Universe, which is not actually observed.

The philosophical significance of ideas, replacement of uniform motion by oscillatory motion, consists in the fact that together with the concept of oscillatory motion, a dynamic idea of the unity of identity and difference in motion entered the science of motion of the body.

The Newtonian view that the body left to itself (free) all the time – eternally and permanently- moves uniformly with a certain velocity, i.e. is in motion identical – invariable in time and space, is replaced by the dialectical view that natural free motion of the body is not only identical – invariable in time, but there is also a difference in the motion itself – in the identity itself, which means that for every naturally-free motion of the body there occurs – there is – is generated a process that tends to reverse gradually this process, i.e. attraction is replaced by repulsion.

Likewise, the basic form of free motion of the body, attraction-repulsion, should not be regarded as an irreconcilable, opposite, confronting phenomenon, but should be understood so that in attraction itself there is – there develops repulsion and they interact with each other. They deter-

mine natural phenomena with their constant contradictions and their final transition into each other.

Of no less philosophical significance is the idea of replacement of uniform motion by oscillatory one, since it gives the theoretical-cognitive basis for elaboration of the concept of development of the solar system and its evolution as a whole. For the theoretical-cognitive basis, attraction as “a force” is not sufficient, is metaphysical and incorrect. After all, every motion consists in a change, in a development in general, whereas we see in attraction only one-way motion, which eventually has to stop.

We do not see any change in uniform motion, except for matter eternally moving away to eternity, which, as we know, leads to the situation when the motion can be either created or destroyed. Therefore, the motion of planets of the solar system and their evolution can be understood not as an attractive force or as uniform motion, but as the interaction of attraction and repulsion, i.e. as oscillatory motion which is just the simplest form of motion.

Where there is attraction, it must be caused by repulsion, therefore, even the philosophers of ancient and modern world were right to state that the essence of matter is **attraction and repulsion**.

Hence it is clear that the process of motion – the process of movement should be characterized not only by velocity, but also by appearance of a counteraction, i.e. appearance of such a process, which by its action tends to destroy the changes in the system caused by the primary process.

Everything moves, everything changes – these words of “Heraclitus” for mechanical processes should be meant not as a spatial position of the body, as is supposed for uniform motion, but as a change in the characteristic quantity of motion, a development of motion, and this is the change in motion velocity, i. e. the occurrence of counteracting acceleration.

Thus, the simplest basic form of motion of matter must be regarded as approach – separation, contraction – expansion, attraction and repulsion, i.e. the oscillatory process, and therefore, we must say that in nature there are only oscillatory motions characterized by their frequency.

All so-called “forces” of the material universe – frictional forces, chemical forces keeping large particles of matter together, elastic forces – making the body retain its shape, nuclear forces making electrons whirl furiously around the nucleus, all the interactions of bodies in the solar system, and the motion of galaxies in the abyss of interstellar space as well as all states of aggregation have the character of oscillatory motion.

This idea was developed by Bernoulli in his work: *Histoire de l’Académie de Berlin* 1753. “On coexistence and superposition of oscillatory motions” and led to the idea, which he formulated as follows: “In every system, reciprocal movements of bodies are always a combination of various simple, proper and conserved oscillations.”

The motion of matter based only on attraction is metaphysical, false, inadequate, half-hearted. Hegel is of genius even in that he derives attraction as a secondary point from repulsion as a primary point; Hegel reasonably stated that the essence of matter is attraction and repulsion, that even Kant considered matter as a unity of attraction and repulsion. From the dialectical standpoint, every motion and the integrity of material systems as well as any process of the existence of any solar system seems possible only in the unity of attraction – repulsion, approach – separation, contraction – expansion.

**In modern mechanics, these processes are called the oscillatory motions.**

The world exists and will exist as an endless process of contraction – expansion, approach – separation, i.e, as a **process of periodic oscillatory motions.**

It should be noted that for fission of nucleus of high atomic number by bombardment with protons, neutrons and “ $\alpha$ ” particles, the bombarding particle must have a very high energy to penetrate into the nucleus.

However, experimental data have shown that it is possible to obtain fission of nucleus of high atomic number at lower, but definite energies of the charged particle.

It turned out that there are certain resonance energies at which not highly energetic charged particles can easily penetrate into these nuclei. For

some nuclei such resonance energies manifest themselves much stronger than for the others.

The existence of resonance energies and their magnitude shows that inside the nucleus there are free energy levels.

It is natural to assume that the atomic nucleus has not only one particle, but an aggregate of particles that execute periodic oscillatory motions with certain frequency, which is precisely the form of their existence, and according to the properties of oscillatory motion, the frequency determines the total kinetic energy of the atom which governs mainly the inertial mass of the atom.

The supposedly uniform motion observed by us is nothing else but the oscillatory motion of relatively high amplitude and long duration of the oscillation period.

By adding these oscillatory processes – contraction – expansion, approach – separation, a natural harmonious picture of the entire Universe is obtained.

#### **§4. OSCILLATORY MOTION AND DIALECTICAL-MATERIALISTIC WORLD OUTLOOK**

The dialectical nature of the definition of free motion of bodies in general as oscillatory but not uniform motion, is expressed in four features that characterize dialectics of the relationship and development of the essence of the motion itself (even of the planets of the solar system) corresponding to four main features of the dialectical method.

**First**, considering natural motion in general, and in particular the motion of celestial bodies in the solar system as oscillatory motion, we thus put in the first place not random, external features of motion, but the internal regular relation of the particular motion to all other types of motion; the conserved central periodic oscillatory motions give rise to all the motions both in inorganic and organic nature of motions.

In favor of the oscillatory motion is the fact that they determine the unity of understanding of all physical phenomena where, under certain conditions, some qualitative forms of motion always transfer into one another in particular ratios. Thanks to the idea of oscillatory motion, physics of the XX century has made great progress, establishing an internal regular link between the different branches of physics.

Considering the process of existence of any solar system in the form of the interaction of attraction – repulsion, i.e. in the form of oscillatory motions, we thereby associate organically the structure of the solar system with all world processes which depend on each other and determine each other in inextricable connection with the surrounding natural phenomena; kinetic theory of the structure of matter, kinetic theory of gases, electromagnetic theory of the crystal lattice, even new quantum mechanics, structure of the atom and its nucleus.

All this points to the unity of the structure of the whole Universe, a united basic form of motion: attraction – repulsion, i.e. the form of periodic oscillatory motions, and from the dialectical standpoint this form of motion is a true theory of matter, it is a form of existence of matter.

**Second** – in the very idea of oscillatory motions, a development of motion takes place, and thereby it is emphasized that despite the equilibrium state of the solar system and the whole system of the Universe, the system nevertheless is not something culminating, something at rest, as in uniform motion, but on the contrary, it shows the ability to move, to develop, to change with its finite transitions into each other, and these periodic processes of oscillatory motions – approach-separation – were observed by means of spectroscopic analysis not only by astronomers of the modern epoch, but also by astronomers of the VIII century, as approach and separation of “fixed stars”.

All these distant galaxies are being continuously separated from one another, and the time will come when in the cosmic future, they will begin to approach.

Similarly, for a billion of years the cosmic dust floating in the interstellar space must thicken into one gigantic star of incredibly high density, so

that there appear new physical processes that would be able to revive not only the solar system with its alive and dead creations, but to open for us the whole visible Universe.

Therefore, the processes of periodic oscillatory motions indicate that here, in global processes, there is a “perpetual emergence and destruction, continuous flow, relentless motion and change”, and these processes must follow each other forever, and then it is easy to understand all the cycles of matter in which it disperses and compresses, and eternally recurring appearance of worlds in infinite time is a logical proof of the existence of innumerable worlds in the infinite space.”

However, no matter how often this cycle may occur in the space, no matter how many countless suns may arise and die, all this points to the fact that the introduction of the processes of periodic oscillatory motions into science establishes firmly the dialectical idea – motion and its changes, its development.

**Third** – defining motion of planets of the solar system as oscillatory motion, we thereby establish: how the development, transformation, and even the change of the planets themselves take place. The quantitative increase or decrease in the frequency of oscillatory motions of which planetary orbits are composed leads gradually to resonance phenomena, i.e. to disturbance of links of oscillatory motions; then at a certain stage of this process, the orbit becomes unstable and ceases to comply with the mobile equilibrium state of the system so that there is a sudden change in the amplitude – the orbit radius, or a sharp change in the orbit and velocity of motion, which causes the change of the mass of the celestial body, i.e. the division of the celestial body.

In all these cases there is a jump, a qualitative transformation of the initial orbit into a new orbit, or even of a celestial body into a new celestial body.

In conformity with the velocity of bodies, molecules, atoms, electrons, protons and other elementary particles of modern physics, the kinetic energy is manifested itself in a particular form: mechanical, heat, electromagnetic,



nuclear, in other words, when this oscillatory motion reaches critical velocity, the matter changes its velocity state and its energy also changes its form.

According to the basic law of nature, the quantitative change of the average kinetic energy of the particles leads to a number of qualitative changes in the properties of matter in general.

Thus, the principle of oscillatory motion for the motion of celestial bodies and bodies on the Earth fully reflects the dialectical law of the transition of quantity into quality that is impossible for uniform motion.

**Fourthly** – Revealing the relationship between the frequency and the amplitude of oscillations, i.e. between the period of revolution and the major axis of the orbit that determines the stability of motion and the mobile equilibrium state of the system, we thereby discover the source of development of the transition, the transformation of opposites. This source is not a uniform motion, but a principle of oscillatory motions, i.e. attraction – repulsion, contraction – expansion, lying at the very heart, at the very essence of matter, and this essence of matter -attraction – repulsion, contraction-expansion – reflects the law of dialectics, the unity of opposites.

Attraction – repulsion should not be considered as something irreconcilable, opposite, confronting phenomena, but should be understood so that in repulsion itself there is, there develops attraction, and all natural phenomena are determined by their finite transition into one another, or into higher forms of motion – this inconsistency lying “in the very essence of things” governs the planetary motion in the solar system and the motion of the whole world.

“The world is driven by contradiction” (Hegel. Logic).

Revealing the content of our definition of motion of celestial bodies in the solar system as the oscillatory motion, we find in it all basic features that characterize the Marxist dialectical method, we find in it an indication of the organic linkage with all natural phenomena and development of the entire solar system and the Universe.

## §5. LAW OF INERTIA AND OSCILLATORY MOTION

Thus, taking into account all the above, we must make a very important conclusion concerning the first law of dynamics – the law of “inertia”.

With all mathematical rigor it has been proved, confirmed by experimental observations and justified from the materialistic-dialectical standpoint that motion of planets of the solar system, the motion of galaxies in the abyss of the interstellar space and all the “forces” of the material universe are governed by the laws of oscillatory motions.

Based on the foregoing, it is necessary to formulate Newton’s first law as follows: “Every free body maintains a state of periodic oscillatory motion until an external cause will forcibly change this state.”

According to the law of “inertia”, oscillatory motions are preserved and by addition give one or another form of the trajectory referred to a particular frame of reference, as a special phenomenon of motion, highly interesting ability of diversion, which can manifest its activity in our spatial representations.

Ancient philosophers interpreted this basic property of matter as a natural motion of a body downward, to its forcible termination. All other motions are induced or forced, generated by an impulse or pressure, etc. (Aristotle).

Using the fundamental views of the ancient philosophers, we can definitely state that every natural – free motion of planets, bodies, molecules, atoms, electrons and other elementary particles of modern physics, is a periodic oscillatory motion with all its regularities, and these oscillatory motions are considered not as the so-called “force”, but as the simplest basic form of motion of matter.

**6. Conclusion.** The necessary prerequisite for the existence of uniform motion, according to the theorem of conservation of motion of the center of gravity, is a point at absolute rest – the center of gravity of the entire isolated system and the first impulse, some force outside nature to set this point in uniform motion. According to the basic law of nature, the unity of opposites, any process, including any motion, is associated with the

change – the development both qualitatively and quantitatively, and is also characterized by the presence of internal contradictions; but as we know, nothing of the kind takes place in uniform motion.

With allowance for all the above, the first law of dynamics – the law of inertia, must be formulated as follows:

“Every free body preserves a state of periodic oscillatory motion until an external cause does not forcibly take it out of this state.”

Thereby we introduce into science the dialectical idea that there are no external sources of motion of matter, motion is inherent in matter itself, and oscillatory motion is the main – the simplest form of motion of matter.

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**EINSTEIN'S SPECIAL AND GENERAL  
THEORY OF RELATIVITY**

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В. В. В.  
09-08-84

Т. С. АБЪИМИДИЗЕ

О некоторых методологических  
проблемах естественнонаучных.  
Часть I  
О специальной подходе теории  
относительности А. Эйнштейна.

Сокращенная на 50%

## **PREFACE**

The aim of this article is to establish the relation between the special and general theory of relativity and the facts of reality.

In no doubt, the mathematical aspect of the theory is very important, and its rigorous solution requires a detailed analysis of this aspect, since a rigorous mathematical solution of a question is entirely dependent on those principal propositions, prerequisites that are given for the mathematical study of the problem.

Mathematics can not be responsible for the essence of some principal propositions divorced from the objective material reality; under these conditions, mathematics turns into formal mathematics which leads to mystical concepts, i.e. to pure abstraction.

Incorrect postulates, incorrect assumptions lead to wrong, incorrect and obscure results despite the correct mathematical treatment of the issue.

These postulates, these basic prerequisites are quite accessible to philosophical discussion, and to clarify the nature of the issue, to make it a subject of discussion, it is necessary to take a different path than the one which is usually followed.

Here, the historical orientation of the issue and especially the analysis of the results are necessary in order to determine which of them have found a fundamental identification in other areas of social life.

## **1. NON-EUCLIDEAN SPACE AND ZELLNER, CROOKES, WALLACE, BUTLEROV AND EINSTEIN'S FOUR-DIMENSIONAL SPACE**

All great philosophers of the ancient and the new world, irrespective of their philosophical world views and regardless of research methods they used in order to understand the mysteries of nature, set an overall task – to identify the “Unity of the Universe” or, following old Pythagoras-Kepler terminology, to perceive the “harmony of the World”, or, according to Faraday and Einstein, to create a theory of the “unified field”, and according to Hegel, Kant and Engels – to show the “unity of the Universe”, the unity of the material world.

And when, after the triumph of Maxwell’s electromagnetic theory, Lorentz, along with Faraday’s concept of the electromagnetic field, introduced an experimentally based concept of the electron as a real particle moving under the action of forces determined by the field, the horizons of physics due to the development of the theory of electricity broadened so much that this led to some difficulties revealed by the negative result of Michelson’s experiment.<sup>1</sup> Then Einstein, on the basis of the “special” theory of relativity, began to create, as he put it, a “unified field theory”, holding for this purpose the principle of “equivalence” of gravity and inertia. Using this principle of equivalence, he explained the well-known fact of identical

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<sup>1</sup> The first experiments of Michelson did not confirm clearly the presence of the ether wind. Einstein took advantage of this fact, following the orders of oligarchs, and created the theory that denied the existence of ether. Further experiments performed by Einstein and his students confirmed the presence of the ether wind and showed a formal, unrealistic character of Einstein’s theory (Ed.).



acceleration of falling bodies, assigned an important part to the equality of inertial and gravitational mass which before, in the classical physics of Newton, had been casual, but was not able to bind the laws of gravity and electromagnetic field in a single mathematical equation, i.e. could not build a theory of “unified field. After this failure, to solve properly the task, he chose the method of Zellner, Crookes, Wallace, Butlerov’s four-dimensional space and by means of a fine instrument of mathematical analysis presented it in the form of abstract equations

Thus, in theoretical physics, there appeared a new concept that made it possible to move away from the Cartesian description by figures and movements without developing a pictorial representation of the experimental results and building only ideal logical-formal structures through our consciousness.

This new attitude to physical theory, successfully accepted by many prominent physicists, was facilitated by the spread of the philosophical ideas of Ernst Mach and his school to which Albert Einstein belonged. In spite of this, many recognize that in his scientific activity Einstein was a spontaneous materialist [73<sup>2</sup>] [158<sup>28</sup>] [I<sup>1</sup>], because, according to Einstein, particles (bodies) should be included in but not added to the field, as it was done by Newton in his theory of empty space which serves a “repository” of particles (bodies), or by Lorentz in his theory of electrons. But such a quirk towards spontaneous materialism does not alter the philosophical prejudices of Einstein, according to which the laws of motion of particles are entirely dependent on the laws of field. According to Einstein, bodies move in space not on the basis of some laws of nature; the bodies are “humps” of the field – “bundles of energy” in the structure of the field whose equation makes these “bundles of energy” move along geodesic lines [17<sup>11</sup>], [94-97<sup>12</sup>].

If Ernst Mach admitted that things or bodies are “complexes of sensations”, that bodies exist only as a system of symbols created by man’s senses, Albert Einstein went further and brought the train of thought to its logical end showing in his general theory of relativity that even “space and time are only forms of our contemplation – the unity of sen-

sations, a form of intuition that is as inseparable from the consciousness as the notions of color, shape or size “ [20<sup>10</sup>], [220<sup>8</sup>].

Einstein paid attention to this problem – “Euclidean” or “non-Euclidean”, i.e. “imaginary geometry” forms the basis of mechanics – in 1910-1916, while the famous physicist-astronomer I.K.F. Zellner, 1834-1882, based on the concept of absolute infinity established by human logic, long before Einstein, as far back as the beginning of the XIX century, came to the conclusions quite opposite to those we know about nature and argued that simple clear conclusions are based on wrong axioms, such as: assumption and “infinity of time” and the idea of space as having “three dimensions”.

Zellner assumed that the shortest distance between two points is not a straight line, as required by Euclid’s geometry, but is an arc of a big circle with large diameter, which is possible only on the assumption of an imaginary four-dimensional space, [644<sup>3</sup>].

The great mathematician Lobachevsky also took interest in this question as far back as 1829 (see. N. Kovalev “Space and Time, and the principle of relativity in the works of Lobachevsky. Proceedings of the Samara State University, 1922 Issue 3 p. 9 (60); Varichak B.” On the non-Euclidean interpretation of the theory of relativity, “New ideas in mathematics: Collection No.7. p. 44. 1914. S.P.B.) [9<sup>30</sup>], [44<sup>31</sup>].

N.I.Lobachevsky writes in the conclusion of his work, “one would have to investigate what change will result from introduction of imaginary geometry into mechanics and if the already adopted and undoubted concepts on the nature of things that will make us restrict or not assume at all the line and angle dependences meet here. However, it is possible to predict that the changes in the mechanics with new fundamentals in geometry will be such as shown by G.Laplace (Mechanique celte JI Liv I ch. II) who assumed the possibility of any force vs. velocity dependence or, putting it clearer, forces always measured by velocity are subject to a different law than the velocity summation [635<sup>4</sup>].

Lobachevsky who according to the English mathematician Clifford is “Copernicus of geometry” tried to verify experimentally whether in our space there is actually an ordinary – “Euclidean” or “imaginary geometry” using

the method based on the comparison of the parallaxes of two stars, however, calculations did not lead him to any definite result. Lobachevsky writes:

“So, it is very likely that only the Euclidean postulates are really true, though will always remain unproven” [636<sup>4</sup>].

The famous mathematician Gauss also tried to prove experimentally the applicability of the imaginary geometry to our space, but this time by direct calculations of the triangle angular sum at the longest possible distances on the Earth surface. He came to the same negative conclusion.

Einstein’s general theory of relativity is entirely based on Lobachevsky geometry with all its four-dimensional space-time diversity [44<sup>31</sup>].

Space with “four dimensions”, clothed by Einstein in abstract mathematical formulas and called by him a “four-dimensional space-time continuum” is not new; it had long ago been slighted in Europe, spread the wilds of America and had been supported not by abstract mathematical formulas as in the teachings of Einstein, and not on the basis of a priori necessity, but on the basis of “empirical observations” (?) of well-known scientists: zoologist A.R. Wallace, professor from Leipzig – the famous astronomer and physicist I.K.V. Zellner, famous chemist and physicist William Crookes, famous chemist Butlerov and other well-known scientists enjoying scientific confidence in the society for their great discoveries in various fields of science [82<sup>7</sup>, 74<sup>7</sup>, 81<sup>7</sup>, 78<sup>7</sup>].

These brave researchers of Nature, partly on the basis of philosophical considerations, partly implementing fine instruments of mathematical analysis, tried to trace the succession of changes in the Universe throughout the infinite length of time and space and always came to the conclusion, quite opposite of what we know about space and time. They suggested that without any new physical assumptions it is possible to represent space and time as very large but finite, i.e. four-dimensional, and then it is easy to understand all whirls of matter in which matter alternately scatters and consolidates [644<sup>3</sup>], [645<sup>3</sup>].

This mysticism of the fourth dimension certainly marks, according to Zellner and others, “the beginning of a new era in the science of spirits

and in mathematics. Spirits indicate the existence of the fourth dimension, and the fourth dimension indicates the existence of spirits” [817], [827].

As a result of these “experimental studies”, this “new era in mathematics” was studied by the representative of the St. Petersburg scientific society, the great chemist A.M. Butlerov, sent by the society to Europe to study the mysticism of the fourth dimension. A.M. Butlerov himself showed interest in spiritualism, supporting the views of the German scientist Zellner. Upon arrival in St. Petersburg, he wrote the article, “The fourth dimension of space and mediumism”. In this article he outlined Zellner’s opinion on the action at a distance, on the reality of the fourth dimension [963<sup>60</sup>] and on his “experiment” (?) carried out with the help of the American medium Henry Trail in Leipzig, December, 1877, at 11 a.m. Thus, all this long-lasting fourth dimension mysticism strongly promoted at the end of the XIX century by such prominent scholars as Zellner, Crookes, Wallace, Butlerov, and others and giving rise to spirits in science and mathematics, was crushed and entirely expelled from science by the whole course of the development of social life and science [143-158<sup>20</sup>].

At the beginning of the XX century this mysticism of the fourth dimension appears again in Europe through Einstein’s works; then it was spread all over America and, as before, took the form of abstract mathematical formulas and created “free will” of elementary particles and the “annihilation” of matter. This gives a new form to the old results, such as “non-determinism with theological conclusions”, “reason in the natural world”, “man’s place in the God’s world”, “immortality of the soul”, and the like, all of them written by P. Jordan A. Compton and other famous physicists well-known for their famous experiments [15<sup>8</sup>].

No less amazing is the book by the famous Swedish astronomer G. Stromberg, “The Soul of the Universe” [15<sup>8</sup>] and the book of Prof. Bogorastan “Einstein and Religion” [142<sup>12</sup>], where, among many tales, the existence of the world of spirits is proved.

Such statements belong to many prominent physicists, for example, the American personalist E. Brightman says: “the energy spoken by physicists is the God’s will in action [485<sup>8</sup>], [142<sup>12</sup>].

In the early years of his creative impulse, 1905-1915, Einstein supports the “creation of the world” and its “death” and the “end of causality” and “destruction” of time (see I. Kuznetsov [53<sup>8</sup>] M. Karpov [222<sup>8</sup>] – 30). These allegations, according to Einstein himself, are derived directly from his entire theoretical concept [53<sup>8</sup>], abandoned by him later [245<sup>2</sup>], [246<sup>2</sup>], [177<sup>2</sup>], [178<sup>2</sup>] (see Philosophical questions of modern physics, p. 15, 17, 52, 53, 222, 485 ed. 1952. Theory of relativity and materialism. Collection, p. 142, ed. 1925).

The whole theoretical concept of Einstein in the early years of his theoretical élan originated under the influence of the religious worldview generated from his childhood. In the article “Science and Religion”, Einstein openly declares: “I affirm that space religiosity is the strongest and noblest driving force of scientific research (see Einstein. Mein Wiltbild J. // [228<sup>8</sup>]). But in the later years of his life, when Einstein due to the political and social situation had to defend himself against terrorist Nazi organizations, he had to join the peace and progress democracy, which strongly guarded him, and as a result, he lost a certain direction of his ideological and philosophical ground for the original free thinking. Since that time (1925) Einstein’s creative activity ceased. After that, his whole activity was to impart the materialistic character to his former statements, but after 1925 no new creative impulse is observed, and in the last years of his life he utterly turned away from modern physics, especially from quantum physics, calling all this a “game of dice”.

“Physicists consider me an old fool, but I am convinced that in the future, the development of physics will go in a different direction than hitherto” [246<sup>2</sup>]. “But I do not think that the theory (quantum theory) is a suitable starting point for the future development. This is the point at which my expectations are at odds with the expectations of the majority of modern physicists (see. Einstein and modern physics. Autobiography [67<sup>2</sup>]).

Director of the Institute for Advanced Study in Princeton, the physicist Robert Oppenheimer, the winner of Enrico Fermi Prize, who for thirty years had been working closely with Albert Einstein, says, “...but in the last years of his life, in the last 25 years, the link with the past was, in

a certain sense, the cause of Einstein's failures. It happened in the years spent at Princeton, and we should not hide this fact, no matter how bitter it might be. Einstein earned the right to this failure. In those years he was saving himself, tried to prove that quantum mechanics contains a number of contradictions "... that he simply does not like quantum mechanics". He could not reconcile himself with some uncertainty in it. He could not approve the rejection of the ideas of continuity and causality. He grew up with these ideas, he defended and greatly enriched them, and it was very hard for him to see their death, though he himself forged a sword to fight with them. He led a passionate and noble fight with Niels Bohr, disputing the theory which he had created and which he hated. Such cases had also been observed in the history of science before [12<sup>02</sup>].

It is also worth noting here that now they began to talk about the five-dimensional Riemannian space: "Kaluza (1921) introduced five coordinates and a five-dimensional spacetime... Then it rather strikingly turns out that Einstein's equation... in the five-dimensional space fall precisely into Einstein's equations of the same form in the four-dimensional space and Maxwell's equations". A large number of physicists: Einstein, Bergmann, G. Mandel, Fock, Jordan Rosenfeld et al. took part in the development of the five-dimensional theory [44<sup>9</sup>-45<sup>9</sup>], [338<sup>16</sup>].

Reading books by Compton, G. Stromberg, Bogoras Tan, Jordan and others, it is difficult to make out – what is the difference between the "spirits" of Zellner, Crookes, Butlerova and other scientists of the late XIX century and the "spirits" of the above "four-dimensional school" physicists of the beginning of the XX century. In other words – what is the difference between the sensations of Mr. Volkmann and the physicist Crookes who carried out "elegant experiments" in his house in the presence of spectators to establish the materiality of the spirit, and the sensations given by "abstract equations" and "elegant schemes" that could not be "left unnoticed" by "four-dimensional theory" physicists of the second half of the XX century [79<sup>7</sup>-80<sup>7</sup>], [44<sup>9</sup>-45<sup>9</sup>].

Thus, if at the end of the XIX century "elegant experiments"? were performed to prove materiality of unreal spirits and establish certain "regu-

larities” for their appearance and disappearance, in the second half of the XX century no experiments were carried out, and instead “abstract equations” and “exquisite schemes” were derived to prove the immateriality of a real particle and to establish that there was no “regularity” in its appearance and disappearance (double nature of matter, “annihilation” of matter, free will of particles, “uncertainty principle” and the like). These are the consequences of the Einstein’s teaching headed now by some academicians and professors looking for “gravitons”, who are followed by many other scientists dragged by “vagaries of fashion”, gravitational waves.

Many prominent physicists and astronomers: Laplace, Green, Neumann, Zelliger, W. Weber worked at the waves of gravity, or as we now call them “gravity waves” and came to the conclusion that for gravity there can be no question of wave-like movement in any environment without having a risk of assuming any fact contrary to the modern understanding of natural phenomena.

Is not it time for us, physicists of the XX century, to definitively free ourselves from mysticism of the fourth dimension of Einstein, Zellner, Butlerov, and others, the more so, that Einstein calls his famous equation of universal gravitation, for which a four-dimensional space was introduced, “a temporary way out” [81<sup>2</sup>]. He also took up a negative position towards modern physics, especially quantum mechanics, for which he did much more than the creator of the theory Max Planck [83<sup>2</sup>], [178<sup>2</sup>], [146<sup>2</sup>].

In 1947 Einstein wrote to Born: “we turned out to be antipodes in our scientific views. You believe in God playing dice, and I – in the full regularity in the world that exists objectively, which I’m trying to catch in a purely speculative manner. I hope that someone will find a more realistic way, and therefore a more tangible foundation for such beliefs than I could do. “(see *Usp. Phys.Sciences*, vol. 59, no. 1, 1956, p. 130) [178<sup>2</sup>].

Einstein could not accept the uncertainty principle, the rejection of the idea of continuity, even though he had created and enriched these ideas, but later he began to hate them and led a noble, but a passionate struggle against Niels Bohr on this ground [12<sup>62</sup>].

## **2. EINSTEIN'S PRINCIPLE OF RELATIVITY AND ABSTRACTIONISM OF M. SEUPHOR, V. KANDINSKY AND K. MALEVICH**

The character of representation of the creative thought in the arts in general – in landscape painting, or literary poetry, is entirely dependent on the surrounding epoch, philosophy and aesthetic views of the artist, writer, sculptor.

Similarly, in scientific hypotheses and in science, the worldview of a thinker – a scientist is reflected, and communication with the social life always takes place in an indirect way, through the whole chain of mediations.

Hence it is clear that the study of any artistic phenomenon, any literary or sculptural work, any scientific hypothesis, the direction of the whole scientific thought, created by speculative conclusions as a pattern of our consciousness [52<sup>8</sup>] will not be scientific if we do not explore the surrounding epoch, worldview and aesthetics of the author, artist or sculptor. They understand perfectly the inaccuracy of the terminology used, the conditional character of criteria to cover any issue, cashing in on the concepts of validity, wanting to show the correctness of their theories that may be clear only to them, but not to others.

And when you try to find out where the dividing line between the areas of antiworlds is, i.e. between the areas with predominant concentration of antiparticles and those of the real world – the world of reality, it becomes evident that it does not pass through some experimental data, nor through observation of natural phenomena, in other words, here the worldview and outlook of the author of the theory is clearly seen.

Similarly, if we follow the development of scientific as well as artistic and literary thought in the whole historical epoch, we will clearly see that the development of a scientific thought, turning points in scientific, artistic and literary thought are always expressed and characterized by the same fundamental but peculiar representation in all areas of social life in the given epoch.



The era of the late XV and the beginning of the XVI century is the era of deep changes not only in the course of scientific thought and the history of Europe, but also in the world history.

The scientific revolution in various areas of scientific thought was in the offing. This epoch demanded and gave birth to geniuses in all fields. In this epoch there lived and worked the genius of Leonardo da Vinci, Raphael, Columbus, Magellan, Ulbrich-von-Hutten, Michelangelo, Copernicus and many other minds – the talents that enriched humanity in one or another area. This epoch was the epoch of “Renaissance” which required novelty and created the titans of scientific thought, the titans of scientific work in all areas of human life. Thus, the development of social life does not occur separately, incoherently for each field, but it is always characterized in a particular epoch by fundamental identity of a thought-wave in all areas of social life.

It was no mere coincidence that in our epoch all abstractionists and surrealists (artistic movement that emerged in 1924 on the basis of abstractionism of 1908), having neither ideology, no program, proclaimed full and pure nihilism, and their ideas were born in the areas of “higher reality “and “higher reason “and their symbol was nothing, a vacuum, a void [6<sup>58</sup>]. They called Kant, Schopenhauer, Hartmann, Nietzsche, Einstein, Bohr, Heisenberg their philosophical predecessors and teachers, according to whom the world is only one’s own idea – as a projection of a certain existing world will [32<sup>57</sup>], and, according to Andrew White, “proceeding from its content, poetry is the vision of God”, while Fedor Sollogub says:” I am the god of the mysterious world, the whole world is only in my dreams” [33<sup>57</sup>].

Similarly, in our epoch, for Albert Einstein, the world, i.e. “cosmic religiosity is the noblest force of scientific research” [228<sup>8</sup>], and “the world is a form of meditation, a form of intuition” [20<sup>10</sup>]. For Heisenberg, Max Born, P. Jordan, and K. Compton the world is not bound by any laws and is characterized by complete groundlessness of occurring phenomena.

The American personalist E. Breitman states: the world is the “energy and physics is God’s will in action”[485<sup>3</sup>], and the existence of “world of

spirits” is proved by the astronomer G.Stronberg, the physicist Bogoras-Tan [142<sup>26</sup>], [15<sup>30</sup>] and others.

What aesthetics, worldview and surrounding epoch we can see in these abstractionists, surrealists, relativists, deists, whose ideas are born in the areas of “higher reason” in the form of “spirits” and are embodied in the mysterious dreams of religious and intuitive revelations of Kandinsky, Malevich, M. Seuphor, G. Strömberg, E. Brightman, Bogoras-Tan, P. Jordan, K. Compton et al., for whom “natural reality is something quite different from the distorted image of this reality in human minds” [110<sup>57</sup>]. Here, the principle characterizing truly scientific and artistic methods is realized in a perverted form. For example, the canvas of Valsonne – “Image”, the painting of American Sam Francis of 1960 – “Compositions” or Salvador Dali’s painting of 1946 – “Temptation of St. Anthony”, the canvas of Kandinsky of 1920 – “White Lily”, of Malevich (1913) – “Black supermetric square” and many others [93<sup>57</sup>], [120<sup>57</sup>]. “The symbols” or “signs” given in these paintings are arbitrary, have no validity and, in fact, can be “understood” only by the artist himself [120<sup>66</sup>], and not by others.

Similarly, in scientific thought, in scientific theories, the loss of the real-actual is represented and a distorted image, picture of the reality is given in the form of abstract equations which do not have any validity, which can be “understood” only by the authors of these theories, but not by others.

Einstein states it clearly and definitely: “I hope that somebody will find a more realistic way, and correspondingly more tangible foundation for such beliefs than I could do” [130<sup>52</sup>], [178<sup>2</sup>], calling it all a “game of dice [178<sup>2</sup>].

The famous English physicist J. Thomson writes about it more clearly: “I have to admit that no one has yet succeeded in expressing clearly what the theory of Einstein actually is [225<sup>13</sup>].

Even more incomprehensible is the “dualism of will and particles” of de Broglie about whom the author of this theory writes: “The way this association of will and particles can reasonably be understood is not quite clear” [212<sup>11</sup>].

The same must be said about the writers who deprived matter of its form of existence, its main attribute of movement, announced it inert – in-

active, and instead gave the world the “bundles of energy” – “concentrated energy” [219<sup>14</sup>] in a curved four-dimensional space, proclaimed the principle of uncertainty, denial of determinism and made a cult of the annihilation of matter and its causeless transformation back into energy.

All this seems to be “clear” (?) to the authors of these theories, but not to others, and therefore generates in them supernatural “spirits” – “immortal souls”, etc. And if we examine the modern science of these authors and the whole chain of their mediators, we come to the sad conclusion that all their works and their creative activity are of religious character – “good thoughts” come from religious motives, interweaving with ideological and theological views. On the basis of these arguments borrowed from modern science it would be possible to conclude that since 1927 (the year of appearance of the uncertainty principle – indeterminism of Heisenberg, Born, Bohr, and others), the religion has become acceptable to common scientific mind [140<sup>26</sup>].

This higher sphere of religious inspiration seems to be a major and fundamental difference between the “relativists” and “surrealists” inspired by the sphere of «Sublime essence» (highest mystical essence) [186<sup>50</sup>], these two spheres being identical in content but different in name and eventually leading to “God.” But they are close in the loss of a real content and in complete degradation of established forms of thinking that, after all, are logically connected with nature in full harmony with reality.

Based on this outlook, i.e. taking such mystical backgrounds from the sphere of otherworldly reason as the basis for the structure of the world, the world would have become and really became curved – four-dimensional, rich in otherworldly spirits [80-82<sup>7</sup>] even despite the correct mathematical treatment. Mathematics can not be responsible for the very essence of initial assumptions divorced from the objective material reality; under these conditions, mathematics turns into format mathematics that leads to mystical concepts, i.e., to pure abstraction.

Even after such a correct mathematical treatment every unprejudiced reader – spectator sees at first sight the absurdity of one or another creation. However, theorists – subjectivists create a whole system of “evidence” to

justify the progressive nature of their theory, speculating on the concepts of multidimensional space, higher reason and trying to justify their existence by means of agnostic conclusions.

From the aesthetic standpoint, the theory seems well-balanced and elegant, giving greater credibility to many “relativists” [21<sup>59</sup>], or rather lovers of abstract equations, who, by analogy, with good reason can be called “abstractionists in science”.

Further evolutions (abstract equations T.A.) led to the areas of the universe, which expand and contract, i.e. “to the areas of the pulsating universe, antiworlds – the areas with predominant concentration of antiparticles or areas where antigravity can occur “ [41<sup>9</sup>].

The correct mathematical treatment of these four-or five-dimensional spatial coordinates in abstract equations gives such aesthetic satisfaction that a “rare theorist (“abstractionist in science” T.A.) could in his day remain unmoved by this exquisite scheme” [45<sup>9</sup>].

Based on abstract equations, “Einstein established the unity of the metrics and gravitation (what gravitation? T.A.) and related both of them to the distribution and motion of matter in outer space. This relationship is expressed by Einstein’s equations of gravity, which should be recognized (according to abstractionists in science T.A.) one of the greatest achievements of human genius [21<sup>59</sup>].

Is not the above the embodiment of intuitive revelations, “clear” only to relativists, the more so that in Einstein’s theory there is no above-mentioned gravity, and is only the curvature of four-dimensional space-time continuum making bodies – “these bundles of energy”, according to Einstein, move along geodesic lines?

After all this, quite clear becomes the opinion of Georges Lemaitre, the well-known researcher of surrealism, who, analyzing new trends in the arts and literature, proves reasonably that surrealism was created under the influence of different trends, both from abstractionism, and from the principle of relativity of A.Einstein, from the poetry of Rimbaud Letromona, cubism, and from the complementarity principle of Bohr and Heisenberg [186<sup>50</sup>].

According to Lemaitre, surrealists (artists, writers L.Selin, Kafka, and I.S. Miro, I. Grenavi, Henry Missouri, and others.) thought that the higher reality is beyond the limits of our reason, they believed in the mystical supreme essence (“Sublime essence»), where pure reason cannot help them, and that everything given by logical thinking should be rejected to achieve this higher ideal [186<sup>50</sup>].

The artist must break the bonds of practical and logical thinking, get rid of the mind censor, completely release his dormant unconscious forces and suppressed mystical tendencies [196<sup>50</sup>].

Do not we see and learn all this in the general theory of relativity of Einstein, when his followers – relativists, like surrealists, argue that we must abandon the conventional postulates that seemed “unshakeable” and fully justified by so-called “common sense”, with its logical conclusions, and be content with abstract equations to build through our consciousness formal structures of four-dimensional space-time continuum with peculiar curvature and peculiar spirits [82<sup>7</sup>].

Is not there a complete lack of logical thinking and the release of mystical tendencies, when we try to prove, according to Einstein, that real bodies are special areas of «surrialite» of the gravitational field not existing in reality?, representing them as humps in the structure of this field?, that they are the incredible concentration of energy [219<sup>14</sup>], [170<sup>11</sup>], [24<sup>12</sup>-27<sup>12</sup>].

Is not all this is a disturbance of subconscious forces and mystical tendencies? or, for example, a description of the picture of the world – the motion of a body or any particle not on the basis of the laws of nature, but on the basis of some abstract space equations of the curved space making these bodies move along geodesic line? [170<sup>11</sup>], i.e, the equations of gravitational field contain the equations of motion of a body [19<sup>55</sup>].

Did not Einstein himself, like surrealists, often say when explaining his gravitational equations, “if not to sin against reason at all, we can generally come to nothing” [301<sup>13</sup>], or, for example, “space and time (relativity) are only forms of our contemplation, that this is the form of intuition” [20<sup>10</sup>], [262<sup>14</sup>] and further: “The concept directly and intuitively associated with a typical complex of perceptions can be called a “primary concept”, ...“con-

nection of elementary concepts of everyday thinking with complexes of perceptions can be understood only intuitively and cannot be subject to any logical fixation [316<sup>51</sup>].

Is not all this stated in the same words and concepts by the famous Italian philosopher, surrealist Benedetto Croce when considering the intuition as primary with respect to the objective world, as the spirituality [26<sup>49</sup>].

This process of intuiting in science is a creation of a new world – a world of Einstein, just as intuiting in the art is a process of creating a new world – a world of abstractionists M. Seifer, R. Delaunay, Kandinsky, Malevich and others. – a world of surrealists (!) F. Pikabbia, P. Klee, A. Kubin and others.

This special world in art and in science has nothing to do with the real life, it is an agnostic theory of symbols in art, a theory of abstract equations (the same symbols T.A.) in science!

According to surrealists, in art there is no cognition of the real world, and according to relativists, in science there are no variables pretending to express physical reality itself [10<sup>53</sup>]. In both cases there is an arbitrary creation of one's own intuitive fantasy divorced from rational thinking, the arbitrary creative activity does not conform with any laws of the outside world.

Is not all the above a direct representation of the whole essence of Einstein's creation, when he says, "no words can come to mind for concepts and combinations of concepts", we tend to attribute complete independence from the language to the act of thinking [13<sup>54</sup>] or, for example, "theory should be built speculatively, and then with a more or less artificial additional postulates adapted to the experimental fact" [36<sup>2</sup>], [73<sup>2</sup>]. According to Einstein, the whole real life, the entire universe is composed of matter and energy, "and is a structure of our consciousness, as a system of conventional signs (symbols T.A.), created by human senses" [52<sup>8</sup>] and, according to relativists, only using abstract equations – as a system of symbols created by human senses it is possible to express the concepts that are beyond our mind.

Is not the Heisenberg's statement on the causeless character of the phenomena in nature unrelated to any laws of the outside world and existing as a structure of our consciousness represented in the system of conventional symbols, a direct surrealist representation leading to religious fantasies [140<sup>26</sup>]. Proceeding from the above, abstractionists and surrealists associate reasonably their "achievements" with the teaching about the wave and corpuscular nature of elementary particles, with Heisenberg's principle of uncertainty, and use successfully in their opuses the denial of determinism, incognisability of the world etc., any absence of material objectivity.

Thus, the perfection of methods and vagueness of objectives – these are the characteristic features of modern physics with its abstract equations reflecting the curvature of multi-dimensional space-time continuum, representing the intuitive imaginations of mystical properties of each self-willed thinker according to his concepts and his imagination, with denial of causality and free will of elementary particles, the dual nature of matter and the annihilation of matter – alternatively the wave, the particle. All this totally reminds abstractionism, dadaism, cubism developing at that time in art and literature and generally the development of scientific thought in our time, i.e. a complete representation of liberated mystics not only in natural sciences but also in the development of art: in art, sculpture and literature.

"The nature is unique! And the law of its development is common for all areas of human life. "We see a half-century history of abstract art and its variety – surrealism both in art and in science, and so far we have not seen any ray of light, although in some areas of science attempts have been made to end the deadlock in which, for example, physics still remains.

A genius is always a genius! Such attempts belong to Einstein, De Broglie, [440<sup>56</sup>], and others, in general, to the geniuses-scientists who introduced and legalized this "abstractionism" in science.

"Physicists consider me an old fool, but I am sure that in the future, the development of physics will go in a different direction than hitherto" [246<sup>2</sup>], said Einstein describing the trend of modern physics as a "game of dice" [30<sup>52</sup>], [17<sup>82</sup>]. "Pondering on this problem throughout all my life, I

came to the conclusion that the method by which this association of waves and particles can be reasonably understood is not quite clear [212<sup>11</sup>].

Leaving behind the orphaned “relativists” and religiously-minded “nihilists” who denied, like the surrealists, everything [94<sup>57</sup>] – matter and its motion, any kind of causality, making cult of the principle of causeless contingencies completely independent of the external environment and emerging somewhere in the highest sphere beyond our mind in subconscious trends, they have long been marking time considering the opinion of these giants of scientific thought changed towards realistic views as a “false direction” [20<sup>59</sup>] and as a “materialist approach to God” [2052]. They state with certainty that “in the last two or even three decades of his life, Einstein was on the wrong way” [20<sup>59</sup>].

We are deeply convinced that these mediators themselves are on the way rejected both by Einstein and Louis de Broglie and their followers (Podolsky, Rosen et al.) [440<sup>56</sup>].

Without any gleams of independent creation of new paintings, new types or new theories in the artistic, literary or scientific fields, somewhere a return to more realistic concepts and real views is even observed (Podolsky, Rosen et al.) [440<sup>56</sup>].

But it is not yet the time to summarize these statements.

To reveal the reality-actuality, it is necessary to take a different path, and as Einstein wrote, “I hope that somebody will find a more realistic way, and therefore more tangible foundation for such beliefs than I could do” [178<sup>2</sup>]. This realistic way and the tangible foundation consists in mastering the traditions of experiments, and, most importantly, in developing the ability to penetrate into the depth of experiments and on the basis of the experience gained from previous experiments to consider the specific data of “Unity of the Universe” – as dialectics of the whole, rather than to explore the area of implicit ideas.

This complex dialectics of contradictions of scientific creative work will give the opportunity to learn the whole richness of nature.



### 3. EINSTEIN. MACHISM, GERMAN NAZISM. DIALECTICAL MATERIALISM

One can rarely see a scientist-genius, as was Einstein, who would reach the halo of glory in the flowering years of his life. Albert Einstein was fortunate to do it, but it was not a mere chance!

At the beginning of the creation of the “theory of relativity” (1905) he was 25 years old, and all this time he was enriching science with genius creations that are tailored to his great idea – the “unified field theory”.

“Until there is no unified field, there is no physics for me” [25<sup>2</sup>] – A.Einstein wrote in his autobiography. In the years of his creative impulse Einstein was religious, and was a member of the Jewish religious community. “In this way, though I was the son of entirely irreligious (Jewish) parents, I came to a deep religiosity”, which, however, at the age of 12 years abruptly stopped [28<sup>2</sup>]. But proceeding from the evidence of the epoch Einstein lived, it happened later, in 1918-1920.

The increasing political and social situation in Germany was not favorable for Einstein due to his hereditary origin.

In response to this, Einstein was welcomed and patronized by the whole progressive mankind, and in 1925 his ideological separation began and was clearly expressed, which continued progressively until his death. “The ideological separation intensified or became evident after the trips of Einstein” [254<sup>13</sup>] from 1919, where Einstein was given an honorable reception, both scientifically and politically, despite his social and, most importantly, national origin. This “triumph in America and in England led to further heat of the social struggle around Einstein and his theory of relativity” [254<sup>13</sup>]. The physicist “Lenard and terrorist nationalist organizations saw in the theory of relativity the triumph of rational thought hated by them. Workers and democratic intelligentsia saw there some opposition to the reaction [254<sup>13</sup>].

Einstein saw and sensed intuitively everything, and he gradually, with a heavy heart, had to stand on the side of the democratic intelligentsia and progressive-minded students. “In the struggle between two worlds of

communism and capitalism, he was on our side and gave an unequivocal response to my (A.F. Ioffe) direct question” [26<sup>2</sup>].

Subsequently, the political tensions in Germany were growing, and Einstein had to leave Germany and move to America (Princeton. Institute for Advanced Study). Political events were escalating, and at the same time there was the rise of the struggle between the reaction and the progress of peace and science, and when, after the long struggle, democracy of peace and progress has triumphed, Einstein and his associates and fellows in science, Levi,Civiti, Infeld and others were already in the blaze of glory and democracy.

Einstein was invited to many countries around the world, and everywhere his arrival was taken as a joyful event. Enthusiastic receptions, meetings, luxury offerings – all this was accompanied by complex rituals, even up to gun volleys at each exit from the residence.

In such a socio-political situation, Einstein gave to his previous statements the definitions of materialistic character.

Meanwhile earlier, before full separation, it was successfully proved by the four-dimensional space-time continuum – the curvature of space, that the world is boundless, but finite, that bodies are specific areas of the field, so-called “humps” in the structure of the field [179<sup>11</sup>], “bundles of energy” i.e. “the areas of incredible accumulation of energy”, and in the gravitational field there move not the bodies and the particles obeying certain laws of nature, but the gravitational field completely defines or, more precisely, makes these “bundles of energy” move according to the laws of the gravitational field [170<sup>11</sup>].

According to Einstein, space and time are forms of our contemplation, the unity of sensations, forms of intuition as inseparable from the consciousness, as the concept of color, shape or size [220<sup>8</sup>]. This space in our contemplation is boundless but finite, and is in the pulsating state, contracting and expanding to a certain extent [194<sup>26</sup>], [195<sup>26</sup>].

And if all this was said in the early period of his creative scientific upsurge, after the “separation”, we hear a different definition of space.

Space is determined by the movement – the presence of bodies, i.e. space and time is an inherent property of matter itself, it does not exist without matter. “Earlier it was believed that if all material bodies disappear from the universe, time and space will remain. According to the theory of relativity, “time and space disappear together with the bodies [253<sup>13</sup>],” as stated by Einstein. No materialist could give such a precise and exhaustive answer.

This is not a limited and finite space, for which his followers even calculated the radius. After the “separation” it has expanded and become infinite.

If young Einstein speaks of the need for speculative structures to cognize the real world, that the theory should be built speculatively and then with a more or less artificial additional postulates be adapted to the experimental facts [36<sup>2</sup>], later the speculative structures were replaced by experiment, “all that we know about the reality, proceeds from experiment and is completed by it”[99<sup>13</sup>] or “Geometry becomes a physical science, since its axioms contain the statements relating to the objects of nature, the statements the validity of which can be proved only by experiment “[99<sup>13</sup>],” that physics should represent reality in space and time without mystical long-range actions”[17<sup>88</sup>]. Einstein believed in “the objective reality of physical existence independent of the observer,” says Max Born [179<sup>2</sup>].

If at the beginning of the emergence of the general theory of relativity, four-dimensional space was defined by four coordinates regardless of time – (world axis), in other words, “since the laws of nature in the theory of general relativity retain their shape regardless of the arbitrary choice of four variables X1, X2, X3, X4, the latter have no independent physical meaning.

Therefore, X1, X2, X3, for example, do not denote, in general, three linear sections which can be measured by the scale, and X4 is not a time determined by the clock. Four variables have only the character of four numbers-parameters and do not always allow for a material, real interpretation. “This definition of space and time, along with the science, in the early years of his activity seemed to Einstein a “creation of human mind with its

free ideas [261<sup>14</sup>], and as Einstein used to say, “if not to sin against reason at all, you can generally come to nothing “ [301<sup>13</sup>].

Thus, “space and time in the description of nature do not have values of real physical things,” [72<sup>17</sup>], but Einstein and his like-minded associates had to change this Machist thinking under pressure of that part of the democratic-progressive society which protected them as a “tender plant” from Nazi terrorist groups.

As a result, the four-dimensional space was already considered as a space with three coordinates with addition of the fourth coordinate, the fourth number – time. “In the surrounding usual three-dimensional space, the position of each point is determined by three numbers. If we add the fourth number – time, we obtain a geometric representation – the event of being of a material particle at the given point at the given moment [11<sup>13</sup>], [193<sup>26</sup>].

This is similar to how “in the five-dimensional space of Kaluza, the equations exactly fall into Einstein’s equations of the same form in four-dimensional space and into Maxwell’s equations”[44<sup>9</sup>-45<sup>9</sup>], [337<sup>16</sup>].

If at the beginning of his creative élan the complexes of sensations served for Einstein as the objects of science, and, according to Mach, science was “the creation of human reason with its freely depicted ideas and concepts” [261<sup>14</sup>], later, after the separation, all this was replaced by antipathy to Mach’s philosophy and they even said about “a radical opposition between his knowledge and the knowledge of Mach [379<sup>13</sup>]; and answering the question of the philosopher Emile Meyerson at the Sorbonne about Einstein’s attitude to Mach’s philosophy, Einstein said “poor philosopher” [256<sup>13</sup>]. Although in the article on the death of Mach, Einstein recognizes the significant influence that Mach had on him. And we can safely say that the special theory of relativity is precisely the brainchild of Mach [258<sup>12</sup>].

If in the 1920s, living in Germany, Einstein, without any hesitation, signs the anti-Soviet proclamation prepared by a group of German scientists [91<sup>43</sup>], then, being at Princeton after the separation, **“he was on our side and to my direct question gave an unequivocal answer”** [26<sup>2</sup>], **“and**

according to the now available information, he even formally joined the Communist Party” [55<sup>12</sup>].

In the first years of his creative élan Einstein also supports the “creation of the world”, and its “death” [53<sup>8</sup>], and “cosmic religiosity” is his strongest and noblest driving force of scientific research [228<sup>8</sup>], then later, to the question of the Archbishop of Canterbury “in what relation are the theory of relativity and religion? “Einstein immediately said, without hesitation:” no relation at all”, which fully satisfied the Archbishop [254<sup>13</sup>].

If in the prime of his creative thought Einstein enriched quantum mechanics, supporting the idea of discreteness and non-determinism by a number of witty examples, persistently proved the uncertainty principle, and basing on these concepts came to the conclusion that the light is not only waves but also electrons, and then, together with Louis de Broglie applied this concept first to electrons and then to the whole matter, after the separation, working at the Institute for Advanced Study in Princeton, Einstein argued that quantum mechanics contains a number of contradictions, that he simply does not like quantum mechanics, that in quantum mechanics one cannot be reconciled with the element of uncertainty, and did not share abandoning of the ideas of continuity and causality.

Although it was very difficult for Einstein to be a witness of the death of those ideas created, cherished, protected and enriched by him in his youth, but this fact should not be hidden, no matter how bitter it might, be [12<sup>62</sup>].

Despite all these shortcomings, Einstein’s teaching aroused great interest and attracted the attention not only of specialists in physics, but also of a wide range of scientists and non-specialists. Einstein was able to impart quite a new concept to a scientific thought of the early XX century – building of perfectly logical-formal structures through our consciousness. Einstein made a paradoxical and dramatic transition to a new picture of the world, which is only available to the genius, for he added a lot to what was known before, but could not even expect and imagine that after the

Newtonian conception of the world, such a “crazy” transition to Einstein’s world is possible.

The principle of relativity was developed before Einstein. Poincaré already known many concepts of the theory of relativity [152], he even published an article in the Italian journal [33<sup>18</sup>], this was not denied even by Einstein [18<sup>42</sup>], but philosophical conventionalism impeded him [33<sup>18</sup>].

“Einstein, who was only 25 years old and whose mathematical knowledge was negligible compared to this profound and brilliant French scientist, before him came to the generalization which using and justifying particular achievements of his predecessors, in one stroke solved all difficulties, yes – but in a stroke of a maitre: a powerful mind, guided by deep intuition of physical reality [15<sup>2</sup>] (Louis de Broglie).

Thus, theoretical physicists, standing on the shoulders of giants, saw the world further than the giant (Heine), rushed to the well-trodden track, but not having the giant-mind, brought physics to a standstill, “from which Einstein himself in the later period of his life resolutely turned away” [245<sup>2</sup>]. “Physicists consider me an old fool, but I am sure that in the future the development of physics will go in a different direction than hitherto.” “Today, Einstein’s objections against quantum mechanics have not lost their importance. Today – I think – he would be less lonely in his objections, than in 1936 [246<sup>2</sup>].

“I hope that someone will find a more realistic way, and correspondingly a more tangible foundation for such beliefs than I could do. The great initial success of the quantum theory could not make me turn to the underlying game of dice” [178<sup>2</sup>].

“But neither the philosophy of Bohr, nor the huge success of ordinary quantum mechanics, nor the striking accuracy of the results obtained using quantum electrodynamics could make Einstein accept these theories” [177<sup>2</sup>].

And all this is because Einstein’s ideas led eventually to the representation of the ability of particles to convert into waves and waves – into particles, free will of elementary particles, i.e. annihilation of matter, the uncertainty principle, etc. Thus, along with the idealist-Machist statements

of Einstein, materialistic statements can also be found, which did not prevent his “relativism” from making a sharp transition from a physical theory to philosophical agnosticism.

#### **4. EINSTEIN’S SPECIAL AND GENERAL THEORY OF RELATIVITY IN THE TEACHING OF PRE-RELATIVISTIC PHYSICISTS**

The special theory of relativity developed by Einstein, appeared in the press in 1905 in the journal: “Annalen der Physik” under the title “On the Electrodynamics of Moving Bodies”, and three months later in the next issue of the journal, there was another work of Einstein “Does the inertia of a body depend on its energy content?”

These two articles, shocked the world, were immediately taken up by theoretical physicists, especially by the Germans, who gave them further substantiation.

The history of science does not remember such a frantic dispute, which went completely beyond the scientific framework and was transferred to the political and dogmatic areas. Such was the epoch in which the special theory of relativity could advance.

If it were not for this era of democracy, peace and progress, and nor the German theoretical physicists who defended Einstein and his theory of relativity from racist attacks, the theory of relativity of Albert Einstein could not have advanced like many discoveries in science.

Long before Einstein’s work, experiments had been performed in this area and many works not discussed here had been devoted to this subject. We will note only the work by J. Babich of 1839 who let a beam of light pass through two identical glass plates in different ways: the beams passed through one plate in the direction of motion of the Earth, through the other – in the opposite direction.

By interference these beams exhibit the same pattern as in the case when both beams are moving in one direction.

Fizeau performed experiments to test the question of convection or non-convection of ether. Water was passed through two tubes of equal length in opposite directions with “exaggerated” constant speed. Comparing the interference fringe shift, the velocity of light in stationary and moving water can be determined. However, the displacement of the interference fringes does not occur if the air was moving through pipes with considerable velocity.

Of all the works on the electrodynamics of moving bodies, the works by Descartes, Lorentz and Poincare were most important in the pre-relativistic period. In 1886 Lorentz published a paper “On the influence of the Earth’s motion on optical phenomena,” where questions of electromagnetic and optical phenomena in systems with translational motion (i.e., all bodies on the Earth, in particular) were considered. Lorentz studied in detail Michelson-Morley’s experiment, and on the basis of his theory of 1892, along with Fitzgerald, came to the conclusion that here, too, the body shrinks in the direction of its movement, and, consequently, in the direction of motion of the Earth, by the amount:

$$l = l_0 \sqrt{1 - \frac{v^2}{c^2}}$$

where  $v$  is the moving body velocity,  $c$  is the velocity of light in free space.

Accepting this proposition, we can easily explain the resulting discrepancy in the experiment of Michelson and Morley.

Lorentz believed that “it is only a formal transformation, which serves him to simplify equations. Einstein gave an entirely different meaning to Lorentz transformations (Lorentz agreed with Einstein’s interpretation) “[74].

**Poincare altered and supplemented the Lorentz transformation, but the results are essentially consistent. Although the scope of issues discussed by Poincare is very important for building the special theory of relativity, the research carried out by Lorentz is more stable.**

**“The role of Poincare in establishing special relativity is often underestimated. Louis de Broglie and O.A. Staroselskaya-Nikitina think**



that the reasons for the underestimation of his contribution to the creation of the theory of relativity are in philosophical conventionalism of Poincare. D.D.Ivanchenko believes that the causes of oblivion of the role of Poincare are: 1) publication of articles in a large Italian Mathematical Journal almost unknown to physicists; 2) Einstein's work was taken up by a big army of German theoretical physicists; 3) lack of confidence of Poincare towards his own results [33<sup>18</sup>].

“The formalism of four-dimensional transformations as described in the article by Poincare forestalled mathematical constructions of Einstein and even Minkovsky. But first of all, it forestalled the physical constructions of Poincare” [265<sup>29</sup>].

Leopold Infeld believed that the special theory of relativity without much delay would have been formulated by Poincare if Einstein had not done it. Einstein did not deny it.

Yes! That's right! “But as for the general theory of relativity, the case is somewhat different”.

“I doubt whether it would be known now” [184<sup>2</sup>] – said Einstein. I wish to emphasize that not only for the theory of relativity, but also for the other cases, as we shall see below, the epoch in which the scientist lived and worked was crucial for advancing any scientific discovery or even invention.

In 1769, James Watt, who in 1769 received a patent for the improvement of the steam engine, died in poverty, and in the same year, a mechanic who received a patent for the invention of women's studs for headdresses, died in luxury. Pythagoras, Aristarchus of Samos, and others were exiled from the country for the heliocentric doctrine. Christianity defeated all the scientific heritage of the Greeks and the Arabs. In the Paris cathedral in 1209 and in the Lutheran cathedral under Innocent III in 1215 Aristotle's physics and mathematics were subject to prohibition for causing heresy, and by the order of Gregory IX in 1231 Aristotle's books on mathematics and physics were banned from circulation. In 1251 the University of Paris approved the edition of the works by Aristotle, and a century later

no one could get an academic degree without satisfactory knowledge of all Aristotle's works.

“In 1490 in Spain, in the city of Salamanca, in the square Stephen, by the verdict of the Inquisition, more than 5000 books of different titles, including many interesting works on mathematics, physics and astronomy were burnt. Many works useful for mankind, disappeared forever just because they involved the views contradictory to firm **scholastic theologians**.

Englishman Roger Bacon – one of the most daring minds of the Middle Ages, who as far back as the thirteenth century stated that **neither the authority, nor dogmata, but reason and experiment should be the sources of knowledge, was imprisoned for 14 years in a dungeon.**

**In 1553 the protestant Calvin burned in the fire the Spanish physician Michael Servetus, who studied blood circulation” [196<sup>27</sup>]. The situation somewhat improved at the end of the fifteenth century. Copernicus was not only cordially met, but the papal authority even requested Copernicus to give them the exact system of calculation of the motion of the sun and the moon, which might serve for a long time to establish the dates of religious holidays. But this situation did not last long, and again, in 1600, in the square of Flowers in Rome, the Inquisition burned J.Bruno for the same teaching, and in 1633 Galileo appeared before the court of the Inquisition.**

In these conditions of a fierce persecution and terror, the possibility of successful development of science was for long suppressed, because knowledge cannot move forward if the creative thought of a scientist is artificially limited by a range of ideas that have evolved over time on the basis of ignorance and superstition.

Hegel wrote in «Naturphilosophie» Teil 2 p. 981: “Laws of absolutely free motion were, as is known discovered by Kepler; this discovery is worthy of immortal fame. Later, they said that it was Newton who was the first to prove these laws. It is more than unfair to attribute a fame not to the one who first discovered the law  $\frac{A^3}{T^2} = \frac{A}{T^2} A^3$ , but to another person and together with Newton to call it “general gravity” [349<sup>7</sup>].

Hegel emphasized the fact that Kepler, who died in Germany in poverty, was the actual founder of modern mechanics, and that Newton's law of gravity was already contained in all three Kepler's laws, and it is clearly expressed in the third law [270<sup>7</sup>].

Leon Foucault (1819-1882), the famous French physicist, gave an experimental proof of the Earth's rotation around its axis by means of the experiment with a pendulum which was carried out at the Paris Observatory in 1860. Two hundred years earlier, **in 1661, the same experiment with a pendulum was carried out by the Italian scientist Viviani in Florence, and then, in 1833, Bertolini in Rimini received satisfactory qualitative results** [161<sup>36</sup>]. But by efforts of French scientists, the experiment and fame was attributed to L. Foucault.

The discovery of the Heilbronn physician Julius Robert Mayer (1814-1878) of the numeric value of the mechanical equivalent of heat (1842) was a real event of paramount importance, and he, with his original thinking, made the greatest revolution in the thinking of scientists, especially his basic idea of conversion of the same mechanical energy into other forms of motion of matter will forever remain an inviolable, unshakable truth.

But the spite and envy of the surrounding circle of scientists, close professorate, with their spoiled and unhealthy nature, always hindered the development of new ideas, new views.

The professor of Berlin University, Poggenдорff, in his collection (v. 2, Leipzig, 1863) writes about Mayer that he died in the madhouse in 1858. Later, in the Augsburg "Universal Newspaper", which was considered a professorial body, he corrects his "wicked nonsense" and writes, "is not dead (as appears in the Augsburg newspaper in 1858, in the madhouse), but is still alive" (1868). The same newspaper warned readers about the "imaginary discovery of the dilettante" MD. Mayer.

Such an attitude to the discovery of paramount importance from the circle of scholars, who spread the rumor about the physical and spiritual death of Mayer, became a tactic of silence and misinterpretation of the essence of his works. This contributed to the fact that the discovery of the German scientist was nearly attributed to the English scientist James

Prescott Dzhoulisu, but due to proper measures taken by Mayer in the press (1851), it did not happen [397-399<sup>34</sup>].

From these examples it is clear how important is the circle of scholars and the epoch in which a genius lives and works.

But let us now leave the “electrodynamics of moving media” and make an overview of the major works devoted to the special theory of relativity which deals with the change of the inertial mass with velocity of travel, i.e. according to the Lorentz formula, the greater the velocity of the body, the greater its inertial mass by the amount:

$$m \approx \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

where  $m$  is the moving body mass,  $m_0$  is the body rest mass,  $v$  is the moving body velocity and  $c$  is the velocity of light in free space.

The change in the inertial mass versus velocity can be found in the works of Descartes, Euler, Laplace – “Celestial Mechanics”, Jacobi – in the famous lectures on dynamics; Hertz – “Principles of Mechanics”; Kirchhoff – “Lectures on mechanics”; Meshchersky – “Dynamics of the point of variable mass”.

In addition, one can call many physicists and astronomers, who considered the inertial mass as a variable: Dufour, Hilden, Tisserand, Rayleigh, E. Rout and others.

The change of the inertial mass versus velocity is best of all, even better than modern ideas, shown in the work by Descartes. In one of his works he writes: “One can say with certainty that the stone is not equally ready to a new momentum, or to an increase in velocity when it is moving very quickly or very slowly” [243<sup>12</sup>], [116<sup>19</sup>].

Later, in 1898, Professor N. Umov attached great importance to the statement of Descartes and claimed that the mass of bodies at velocities close to the speed of light will increase significantly [167<sup>21</sup>], [67<sup>8</sup>].

As we can see, the change in the inertial mass in the special relativity theory (discussed), is taken into account only at speeds close to the speed

of light, and Descartes and other scientists considered it even at a normal speed, and in general the change of inertial mass depends strongly on the rate of change of the process.

A jet of water ejected under high pressure can not be severed with a sword, a rifle bullet breaks through the open door, but cannot close it due to a sharp increase in the resistance to the acting force at the rapid change of the process, which we call the inertial mass of the body.

By accepting this conclusion with respect to the inertial mass, in other words, rejecting the old concept of inertial mass as a measure of the quantity of matter, it was no longer difficult first for John Thomson, long before Einstein, and than for Einstein himself to make a conclusion on the convertibility of the inert mass into energy and vice versa. Einstein writes: "The mass of a body is a measure of the energy content in the body; if the energy changes to  $\frac{E}{9 \cdot 10^{20}}$ , then the mass changes in the same direction by the quantity E, wherein the energy is measured in ergs, and the mass in grams." [178<sup>22</sup>],  $M = \frac{E}{c^2}$  [186<sup>2</sup>]. Here, by the mass the inertial mass is implied.

We cannot but mention here the work of Joseph Thomson, who gave the same formula, based on the same conclusions:

$$M = \frac{E}{c^2}.$$

"This formula was derived by Joseph Thomson long before Einstein and was ignored by bourgeois science" [110<sup>12</sup>]. In the literature, the well-known law of Thomson-Einstein:  $E = Mc^2$  is often found [571<sup>6</sup>], [585<sup>6</sup>].

Here, similar works should be mentioned – inertia of energy, or energy flow, developed by Maxwell, I. A. Umov and others. P. N. Lebedev was the first to prove the pressure of the light flux and then derived the famous formula of mass. **Therefore, experimental confirmation of both laws can in no way be construed in favor of relativism and against classical physics [175<sup>12</sup>].** "This relationship between inertial mass and energy is confirmed by the entire course of development of nuclear physics where in all processes the conversion of the internal kinetic energy of initial

nuclear particles into other types of energy takes place and is one of the fundamental laws of physics”.

And this fundamental law, discovered by D. Thompson, P. Lebedev, N. Umov long before the relativistic physics, did not find the appropriate application until Einstein gave his explanation. “Genius is not someone who knows a lot, but the one who gives you a lot of new.” Such people among others were Newton and Einstein.

**Taking all this into account, we cannot be superstitious like others and consider the glory of the geniuses of science as something final and inviolable.**

“I personally (V. A. Fock) do not agree with such deification of Einstein and think it is wrong to create a halo of infallibility around him” [16<sup>59</sup>]. “I (V. A. Fock) have no doubt that scientific criticism of Einstein is quite compatible with the most profound respect for his genius” [22<sup>50</sup>].

The expression of cautious doubt cannot diminish either dignity, or doubt, or fascinating character of scientific problems.

It is time! It is time to leave these senseless cries in honor of the modern genius of Einstein. Contrary to the accepted misunderstanding we will not overestimate the merits of Einstein in the field of inertial mass changes with speed, of establishing the relationship between the inertial mass and energy in the four-dimensional space and in the field of “independence” of the speed of light and draw reader’s attention to the unpardonable guilt of scholars of the epoch of Decartes, D. Thomson, Henri Poincare, N. Umov to science in that they could not reach the perfection of Descartes, Poincare, Thomson, N. Umov, Platon Lebedev’s teaching and by silent mockery killed the great true idea – mass change with speed and the relationship between inertial mass and energy.

Thereby they not only slowed down the advance of scientific thought for three hundred years, but allowed the scientists of the next epoch to inflict injustice towards Descartes, Poincare, H.Umov, P.Lebedev. **In the new epoch this attitude toward science developed a “compulsion to recognize” new discoveries, where the criterion of evaluation of these discoveries is not weighted strict conclusions and fundamental success,**

**but the accomplished fact of adaptation to the experimental facts, and even strikingly weak unmotivated conclusions do not give rise to criticism.**

**Along with this, mutual praising of popular authorities leads young people astray, and they do not even think about looking for something creative besides these figurants of science and fleeting advertisements, and do not even assume that the living spirit can be born somewhere in the works of free creative natures like them.**

As can be seen from a number of these examples, the authors of the great discoveries of fundamental character who had a substantial impact on the development of scientific thought, did not foresee the true significance of their discoveries.

“The importance of these discoveries became apparent in full later, and it is not often disclosed by the author of the discovery, but by somebody else (!) [74<sup>2</sup>] when it was required by the epoch”.

And if D. Thompson, who gave the famous formula  $E=Mc^2$ , or Lorentz and Henri Poincare, who were the first to formulate the theory of relativity, or Descartes and N. Umov who clearly and definitely reflected the change of the inertial mass with speed in their scientific works, failed to apply their famous discoveries, it happened naturally not because their genius was not strong enough!

Outstanding people, no matter how great their genius in all areas is, solve the problems set by the historical development of the productive forces and productive relations of their epoch. This fully applies to the above facts.

In 1904, at a convention in St. Louis, Henri Poincare, proceeding from the principle of relativity, also spoke on the fact that there could not exist velocities greater than the speed of light [32<sup>18</sup>]. It was not perceived by the majority of researchers at the convention, and its philosophical groundlessness was shown in many works.

Einstein, who assumed that a ray of light moves in the “resting” coordinate system with a certain speed “c”, regardless of being emitted by a stationary or a moving body, showed its application to explain the theory

of “simultaneity”, and then started to consider the relativity of lengths and times. Theoretical physicists immediately accepted this postulate of Einstein, and so far it has not lost its significance, (experiments of Cantor et al.).

We have discussed fairly well the theoretical works of the special and general theories of relativity, but have said nothing about the experimental verification.

**Some of the main conclusions of the special theory of relativity – the phenomenon known long before Einstein (as has been mentioned above), the change in inertial mass with velocity of travel, the relationship between the inertial mass and energy can not be used in favor of relativism, but because of mathematical and technical difficulties could not be tested in practice in the pre-relativistic period.**

Now, due to the development of theoretical issues and improvement of technical facilities, they have been repeatedly tested and justified in practice, not only in the design of accelerators; the most important theoretical and technical calculations related to the use of nuclear energy also find justification, in particular, the change in the inertial mass with speed and conversion of the inertial mass into energy; and, as we have noted, they are one of the fundamental laws of nature.

As for the experimental verification of the other postulates and conclusions of the special theory of relativity, such as: limiting velocity of light, “proper length” and “proper time”, simultaneity of two events, etc., no methods to compare the results of theory and experiment have been found yet due to the mathematical and technical difficulties either in the pre-relativistic period, or later.



## 5. MICHELSON'S EXPERIMENT AND GENERAL COMMENTS ABOUT THE SPEED AND DIRECTION OF THE EARTH'S ORBITAL MOTION. THE THEORY OF LORENTZ AND FITZGERALD

Accepting the heliocentric system of Copernicus, it was necessary to carry out «experimentum crucis», i.e. decisive experiments proving the daily rotation of the Earth around its axis and most importantly the annual revolution of the Earth around the Sun. For the daily rotation there is the crucial experiment of Fouquet with a pendulum, performed in the pantheon in 1861, and the experiment of Hagen (1910, 1919.) with moving balls for quantitative observations of the rotation of the Earth. Now these experiments can also be successfully demonstrated *in vitro* as a proof of the rotation of the Earth around its axis.

But there exist no experiments («experimentum crucis») to prove the annual revolution of the Earth around the Sun!

The aberration phenomenon is well explained by one-year rotation of the Earth, but this can be explained in a different way with the Earth “at rest”. Parallax displacement of stars is good and true evidence, but its observation is rather difficult and hence the resulting parallax ellipse of stars few tens or hundreds of light-years away from the Earth is almost never observed.

This required more clear and decisive evidence, and one of such proofs is the experiment carried out by Michelson who using his own interferometer wanted to determine the speed and the direction of the orbital motion of the Earth – to determine the existence of the ether wind, and hence the velocity and the direction of motion of the Earth around the Sun.

Michelson's multiple experiments (1881, 1887, 1904, 1909) did not produce the desired effects. “If the experiment gave positive results, it would be possible to determine the velocity of the earth, not only along the orbit, but also relative to ether”.

“It is reasonably believed that the Sun, like all planets, moves through space in a certain direction at a speed of about 20 miles per second. How-

ever, this speed is not very accurately determined, and it was hoped that with the help of the Michelson's experiment it would be possible to measure accurately the speed of motion of the entire solar system through space. Since the experiment gave a negative result, this problem needs to be solved "[183<sup>39</sup>]. Michelson says: "The interferometer was designed to solve this problem" [183<sup>39</sup>].

As is known, Michelson's interferometer has two mirrors in two mutually perpendicular planes, one of which is mounted on a slide, which allows micrometric shift to change the distance of the arm. The light beam coming from the source is incident onto a slightly silvered plate and splits into two mutually perpendicular beams by reflection and refraction. Then, these beams fall onto the corresponding mirrors and being reflected from them, go to the visual tube where the interference pattern is observed.

Michelson, who wanted to prove the motion of the Earth around the Sun and to establish the direction of the motion, used his interferometer by means of which he intended to show the existence of stationary ether, i.e. that there is the "ether wind" when the Earth moves, and then to derive the above conclusion on the orbital motion of the Earth by purely mathematical calculations.

Carrying out mathematical calculations to determine the optical path difference in time between two beams, one in the direction of Earth's motion and the other in the perpendicular direction of this travel, and taking the speed of light as a constant value, he obtained for the difference in time between the optical beam paths quite a sufficient quantity to observe, when turning interferometer about 90°, a shift in the interference fringes. Numerous repeated observations did not show any expected shift of the interference fringes!

The question arises: what conclusion should we draw from all this?

This Michelson's negative result shows that we must either abandon the constancy of the speed of light and accept the Ritz' hypothesis that the speed of light depends on the speed of the light source, which was not confirmed by numerous observations, or accept the hypothesis of Fitzger-

old-Lorentz, according to which there is a contraction of the length of any traveling body by a value  $\sqrt{1-\beta^2}$ , where  $\beta^2 = \frac{v^2}{c^2}$ .

This contraction is not the result of any forces, but simply the fact concomitant with motion, so this statement does not have any physical or philosophical justification.

Despite the fact that Lorentz and Fitzgerald, working at the idea of the length contraction of all bodies in motion, give the transformation formulas a purely formal mathematical interpretation, whereas for the theory during the transition from the fixed to the moving system, the constancy of the speed of light and the resulting “proper length” and “proper time” have a real rather than a formal mathematical value, they consider the structure of our world such that each moving system has its time.

If, to substantiate the negative results of the Michelson’s experiment, we accept the Ritz hypothesis which assumes that the speed of light “ $c$ ” depends on the speed of the source, i.e. assumes geometric summation of the speed of light “ $c$ ” and the speed of the source  $v$  ( $u=c+v$ ), then we should not expect any interference fringes and any shift, and we actually do not get them.

Ritz put forward this hypothesis about the dependence of the speed of light on the speed of the source in 1908 and, as we know, this hypothesis explains easily the Michelson’s negative result. The objections to this hypothesis are not well grounded, but these experiments though not proving the hypothesis of Hertz, do not still contradict the principle of independence of the light speed on the speed of the light source.

The first and main objection seems to be a denial of the nature of electromagnetic phenomena as short-ranged, in other words, the spread of the action from one point to another is determined by immediate proximity to this point rather than by the speed of widely separated source.

Neither the wave theory in its full, nor the corpuscular theory of light phenomena, which Ritz subsequently referred to, cannot deny the dependence of the speed of the light beam on the speed of the light source rigidly connected at least with the Earth, but this principle does not find experi-

mental confirmation since the speed of light was not measured directly from the moving light source.

Neither W.de Sitter's spectroscopic observations (W. de Sitter «*Phis. Zeitschrift*», 14, 429, 1913) of physically linked binary stars whose components have different speed, nor allegedly direct measurements of the speed of light from directly opposite edges of the solar disk made in 1956 by Bonch-Bruевич and Molchanov, can also refute the hypothesis of Ritz due to smallness of the observed quantity and the impossibility to use the interference method because of the incoherence of the light rays emanating from different points of the same source, and no anomalies can be expected at different velocities of motion of the components. Here, the speed of light is not also measured directly from a moving light source.

Experiments not related to the interference of light were carried out, but they do not contradict the principle of the independence of the speed of light on the speed of the light source.

**In general, there exist no experiments to prove that the speed of light does not depend on the speed of the light source. But there are not also experiments proving that the speed of light depends on the speed of the light source. The idea of the constancy of the speed of light, i.e. that the speed of light does not depend on the speed of the light source, was known long before Lorentz, Fitzgerald and Einstein.**

There were scientists who believed that optics and electromagnetism must be included in the field of mechanics and therefore they are subject to the fundamental law of mechanics – the principle of relativity of Galileo, Newton, Descartes, i.e., assumed that the speed of light is summed according to the usual rule of velocity summation. At the same time, many scholars argued that the field of optics and electromagnetism is the field of «snigeneris» (of special kind) and rejected the Descartes' principle of relativity, i.e. they affirmed that the speed of light cannot be summed up with the speed of light.

As far back as 1887 Focht, exploring elastic ether theory, established a formula for converting moving systems called now a “transformation formula” of Lorenz. Similar results, almost simultaneously with Lorenz, were

obtained by the English physicist Larmor in 1910. In 1904, at a convention in St. Louis, based on some Poincare transformations, he, proceeding from the principle of relativity, stated that there can be no velocities exceeding the speed of light [171<sup>48</sup>], [32<sup>18</sup>].

If we take into account the conditions for obtaining interference phenomena, in the Michelson experiment, by rotating interferometer about 90°, no shift of the interference fringes can be expected, even on the assumption that the speed of light cannot be summed up with the speed of light.

In the experiment of Michelson one light beam splits by a slightly silvered mirror into two mutually perpendicular beams, which, due to the multiple reflections from mutually perpendicular planes, multiple refractions and multiple passages through the thickness of the atmosphere are repeatedly polarized, and the polarized beams do not interfere. Bifurcated beams passing through the optical system of the interferometer and the collimator, already have other properties than the original beam before its splitting and therefore neither interference phenomena, nor fringe shift can be expected when rotating the interferometer about 90°.

Besides all this, a beam of light at each reflection from the mirror should be shifted to the right (in its direction) due to the rotation of the Earth – Coriolis acceleration, which can not exert any influence on the phenomenon of interference when rotating the interferometer about 90°.

**In general, there is yet no reason for direct logical conclusions and there are no experimental data that would make us abandon the Euclidean geometry, take the speed of light as the speed limit with all the ensuing consequences, and the postulate of Einstein about the limiting speed of the light beam is in the same state as it was before Einstein, despite the efforts of his followers.**

Famous experiments of Kundta (1888), Voigta (1884), Drude (1820), who, from the definition of the index of refraction of the light beams, found that in some metals Ag, Au, and Cu a light beam propagates faster than in vacuum (the case of anomalous dispersion).

Drude showed that the beam D propagates in Na 220 times faster than in a vacuum (see. Khvol'son. Course of Physics, vol. II p. 307-309, ed. SPB 1904).

As can be seen, the group velocity at anomalous dispersion is higher than the speed of light in vacuum.

A groundless statement that the Rayleigh's formula for the group velocity is not justified because of the strong absorption of light beams, and that the group velocity is not equal to the rate of energy transfer (see. Landsberg. Optics, p. 343, 345) is not valid.

In the X-ray region, air or vacuum will be "optically dense media", and metal and glass – "rare media" (see. Sommerfeld. Atomic structure and spectra. p. 176, G. Kay. X-rays, p. 336, M.R Ware and D. Richards. Physics of the atom, p. 161). Therefore, the phase velocity of the X-ray radiation in the metal is higher than the speed of light in vacuum.

The argument against the above, i.e. that the phase velocity, in general, and of X-ray radiation, in particular, cannot be used for energy transfer and that the photon moves at phase velocity with a slower speed than the wave front, is baseless [161<sup>46</sup>].

This allegation cannot be accepted because it separates matter from motion and considers energy as a separate value independent of matter.

It should be mentioned here that in all methods of determining the speed of light, we measure a group rather than a phase velocity in the dispersion medium.

**Taking all this into consideration, we must conclude that Einstein's postulate on limiting speed of the light beam is absolutely unfounded.**

The question of the non-applicability of the law of velocity summation at high speeds must be associated with the law of variation of the inertial mass with speed. At speeds close to the speed of light and with the rapid flow of the process the inertia of the body (and of any particle) increases substantially, in other words, its energy susceptibility drops to zero and therefore the increase in speed may not occur. "The stone is not equally ready for a new movement or for an increase in speed when it is moving very quickly or very slowly" (Descartes).

"The action of the disturbing force, the frequency of which is very large compared to the natural frequency, does not almost violate the mode

of natural oscillations.” (see N.Buchholz, The Course of Theoretical Mechanics, Part I, p. 262, ed. 1938 [262<sup>38</sup>]).

On the basis of these statements, it is quite possible that the speed of light cannot be summed up with the speed of a moving light source, in other words, the light wave or the light particle – corpuscle, when emanating from the moving light source at a speed of  $3 \times 10^{10}$  cm/s due to its low energy susceptibility will not be able to take energy of the moving light source, and with the rapid change of the process observed here, will not be able to increase its speed.

**Thus the statement of the special theory of relativity that the speed of light cannot be summed up with the speed of the light source is quite acceptable, but there is neither philosophical, nor physical reason to say that the speed of light is the speed limit, and it does not follow from the Michelson’s experiment. Therefore there is no need to introduce new postulates, new hypotheses to explain the negative result of the Michelson’s experiment.**

Nature is unique! And for it, the law and the essence is an integral whole both for macro- and microcosm.

## **6. EXPERIMENTAL VERIFICATION OF THE GENERAL THEORY OF RELATIVITY**

Experimental verification of the general theory of relativity is believed to be possible in three cases: red shift of spectral lines, deflection of a light beam in a gravitational field and relativistic shift of the Mercury apsidal axis. Soundersom carried out experiments with pendulums made of lead and uranium in Thomson’s laboratory in 1900 to define the deviation of the light beam, i.e. the effect of gravity on the radiant energy and, as shown by Likhodsky, the result was similar to that of Einstein. “This calculation does not require the assumption that the geometry near the Sun will be non-Euclidean” [112<sup>12</sup>], which is necessary for Einstein’s experiments.

**“Theoretical proof of the “heaviness” of light was first given by Soldner in 1801 on the basis of the corpuscular theory of light. Sol-**

**chner's formula was re-derived by Einstein in his general theory of relativity (see. Hegel. "Philosophy of Nature", Vol. I, ed. 1934 Note, p. 585).**

We can say with certainty that the deviation of the light beams passing near the Sun's surface is due to the same phenomena which we observe on the Earth – refraction. Indeed, there are different so-called "fields" around the Sun that can bend light rays passing through the thickness of the medium surrounding the Sun.

The red shift cannot also serve as a proof of the general theory of relativity since high energy levels both on the Sun and the stars can shift spectral lines due to a high frequency of the oscillating system.

**Thus, neither for light beam deflection in a gravitational field, nor for the shift the spectral bands towards the red part of the spectrum it is not necessary to reject the Euclidean geometry.**

In general, these observations neither confirm, nor refute the Einstein's theory.

As for the experimental verification of the motion of the apsidal line in the Mercury orbit, "Einstein's equations of motion for the planets have the form of the same classical equations of motion of a spherical pendulum; therefore, the trajectory of planets has the same form as the end of the trajectory of a spherical pendulum "[269<sup>23</sup>]. Since the period of oscillation along the semi-minor axis «b» is smaller than that of the semi-axis «a», the apsidal line must rotate [182<sup>25</sup>]. **Hence Einstein's equations for the motion of the planets and Newtonian differential equations for the motion of the planets are reduced to the same form, to the equations of oscillatory motions where the energy does not change during the oscillation [81<sup>61</sup>].**

Thus, it is clear that the motion of the planets obeys the laws of the oscillatory motions that are actually observed. The apsidal motion of Mercury was known to Arab mathematicians and astronomers of VIII century – Taabit-ben Kora, Al Batanya et al. [115-116<sup>32</sup>], [78-104<sup>33</sup>] and others.

**So, it is clear that the experiments on the apsidal motion were performed well before the relativity epoch, for example, an "elegant" ex-**



**periment for rotation of the apsidal line carried out in the laboratory of the Naval Academy in 1905 [367<sup>24</sup>].**

Einstein's formula of relativistic apsidal motion:

$$\frac{\partial\phi}{\partial t} = \frac{2\phi\pi^2\alpha^2}{T^2c^2(1-e^2)}$$

is the same formula for the Mercury apsidal motion derived by the German scientist Gerber in 1898, 20 years before Einstein, on the basis of Neumann-Helmholtz' theory of kinetic potential [266<sup>12</sup>], [225<sup>12</sup>].

Thus, this experimental verification of general relativity can also be successfully explained on the basis of Euclidean geometry. In addition, we have shown that this formula can be replaced by the expression

$$\frac{\partial\phi}{\partial t} = \lambda^2 \frac{1}{\rho}$$

where  $\lambda^2 = \frac{2\phi\pi^2\alpha^2}{T^2c^2}$  is the constant for all planets;  $p$  is the parameter of the ellipse  $p = a(1-l^2)$ . **Hence, apsidal motion depends on the eccentricity rather than on the curvature of space and therefore this formula contradicts the assumption of four-dimensional space and is in good agreement with the theory of oscillatory motion [182<sup>25</sup>] [367<sup>24</sup>].**

12 years after this work, in the foreign literature and here, in the Soviet Union, articles were published, where the authors found it necessary to introduce orbit eccentricity into the formula of apsidal motion, justifying it by the fact that the closer is the ellipse to a circle, the harder it is to observe the perihelion shift, but without explaining how and why the eccentricity of the orbit is associated with the relativity shift (see. Ginsburg. Experimental verification of the general theory of relativity. Collection in memory of Einstein. Einstein and modern physics).

## 7. I. NEWTON AND A. EINSTEIN

In his autobiography, Einstein wrote:

“Forgive me, Newton, you have found the only way possible in your time for a man of the greatest scientific creativity and the power of thought.”

“Concepts created by you are even today fundamental principles of our physical thinking, although we know now that if we wish to get a deeper insight into relationships we will have to replace these concepts by others that are farther from the sphere of a direct experiment [41<sup>2</sup>].

Einstein did not take into account the politico-religious situation of the epoch Newton lived, i.e. created during the English bourgeois revolution of 1649 which ended by the second, also bourgeois, revolution in 1688, (glorious Revolution) under the slogan: “The law and the constitution,” advanced by the “illegal” ruler Willem van Oranje to whom Newton had to swear (see. Newton’s letter to Dr. Kovel).

Einstein was the greatest and the only scientist of our time, who found a way to discard forever three hundred years of Newton’s metaphysical thinking that had taken root in science.

It was a scientist, by his own words, of “the greatest creative abilities and the power of thought”, who in the prime of the Newtonian era, with his deep original thinking, made a sharp turn in the minds of scientists, who replaced the “force, rotating celestial bodies – the force of gravity” by the “motion in a curved space with large masses of matter”.

He called all this simply a “gravitational field”, in which there is no force, but, according to Einstein, only the “curvature of spacetime”, the term that for some reason is known under the inappropriate name “gravity force of universal gravitation.”

Einstein, just like Newton, was the son of his class, and both were religious. Einstein, deeply religious as a child [288], for a long time was a member of the Jewish religious community, and later helped the community in every way, even by direct participation in its activity.

If Newton, as the son of a small farmer, found common ground with the requirements of the epoch of the English bourgeois revolution, Einstein

could not do it, not because he did not want to, but because the German revolution of 20-40s pursued a misanthropic policy against persons of Jewish origin, and therefore Einstein dissociated himself from them and joined the progressive-minded scholars and intellectuals.

If the political and social situation was favorable to Newton, which manifested itself in getting responsible posts in his country, the things were different for Einstein and he even had to leave Germany.

Taking all this into account, we can safely say that the creative work of these geniuses of their time clearly reflect their experiences, as has been mentioned above.

If Newton entrusted the Creator to give the first impulse to bring the entire global system in motion, Einstein entrusted the Creator to distort the space near large masses to make heavenly bodies – planets – move along them as if along the grooves, like stones sliding downhill.

If Newton and Einstein were not able to apply fully the idea of ancient and modern philosophers and scientists – a “desire” of bodies to move to and away from their center, it happened, of course, not because their genius was not strong enough. Great people solve the tasks set by the historical development of productive relations of their epoch!

Newton was the son of his time. For fear of persecution by the Church and the papacy, he realized one part of the correct idea of the ancient world – “The quadratic reduction of gravity,” calling it – “acceleration under the influence of the attracting force”, but he left up the idea of repulsion dialectically inseparable from gravity to the Creator in the form of the first heavenly impulse to show to the scientific and the political world his deep religiosity which was widely demonstrated by supporters of the English bourgeois revolution of 1688, who advanced a slogan: “The law and the constitution”.

“The only possible explanation lies in the recognition of the divine Creator of the Universe (wrote Newton), who was wise to arrange the planets so that they get necessary light and heat “ (see. Letters to Locke, Bentley) [394<sup>40</sup> [42<sup>40</sup>]. Newton expressed it all in the correct mathematical formulas

of oscillatory motion, but gave them an incorrect, inadequate explanation as a “force of attraction” of the Sun and “inertial motion” [21<sup>35</sup>], [31<sup>35</sup>].

If Einstein, guided by impulse, asked Newton to forgive him for finishing “the concept of the relationships” by other concepts standing away from the sphere of direct experiment, **we have to ask Einstein to forgive us for rejecting without any reason his basic principle of the motion of heavenly bodies borrowed from the ancient philosophers and scholars, for “throwing away” his curved four-dimensional space that drove famous scientists I.K F. Zellner, W. Crookes, A.R Wallace and others to mystics [82<sup>7</sup>], and for borrowing instead the basic form of the motion of matter, attraction-repulsion, approach-removal, compression-expansion [165<sup>7</sup>], i.e., using the language of modern science, “oscillatory motion”, from the same ancient and new philosophers: Democritus, Pythagoras, Aristotle, Kant, Hegel and Engels [72<sup>35</sup>].**

Thus, we can say with confidence, based on some evidence, under the pretext of inner experiences or driven by any feelings and attitude towards the world, that Newton and Einstein, two giants of scientific creative thought, «volens nolens», undoubtedly fell under the influence of religious prejudices, the keynote of their whole scientific heritage, interwoven with the ideological and theological views.

Einstein’s followers are persistently trying to represent the contemporary genius as a materialist [236<sup>2</sup>], calling the views of opponents who dispute the correctness of Einstein’s concept “either stupidity or malice, or a mixture of both of these human traits often going hand in hand” [239<sup>2</sup>].

This orthodox deserted relativist, putting himself on a par with the greatest modern scholar, also calling himself a materialist [236<sup>2</sup>], describes the works of Einstein, who played a very crucial role in the millennial history of scientific creative thought, as “a materialist approach to God?” [205<sup>2</sup>].

What’s more? It is funny not to answer him using his own words: “all this is stated either for stupidity, or for malice, or a mixture of both of these human traits often going hand in hand” [239<sup>2</sup>], or for any other “reasons”. But this is neither surprising, nor new!

Great people by efforts of their pupils often become unwitting “supporters” of distorted ideas.

This happened to Copernicus in the person of A. Oseander who wrote an anonymous distorted preface to the book of Copernicus [485<sup>41</sup>].

This happened to Newton in the person of his pupil Cotes who wrote a distorted preface to the second edition of «Principia [182<sup>42</sup>].

This happened to Einstein in the person of his pupils L. Infeld and V.A.Fock who distorted Einstein’s creative and unrivaled thought prior to the “separation” as a “materialistic approach to God” [205<sup>2</sup>], and described the corrections of the materialistic nature made by Einstein after the “separation” as false, saying: “one can not shake off the impression that Einstein is on the wrong way” [20<sup>59</sup>].

Of course! I’d better represent with reverence Albert Einstein in his creative ideas even of idealistic character and, realizing fully his genius, bend down before his talent, than represent him (in the description of such followers), as a scientist who took the wrong track in his corrected works and a “materialistic approach to God” ? [205<sup>2</sup>].

## 8. CONCLUSION

**Thus, by studying the special theory of relativity, we find that the main conclusions of this theory: change in the inertial mass with speed, relationship between the inertial mass and energy  $E=Mc^2$ , independence of the speed of light on the speed of the light source, considered to be the fundamental laws of physics and as if “confirming the correctness of the special theory of relativity, do not require the relativistic theory and well before Einstein were developed perfectly by Descartes, D. Thomson, Poincaré, N.Umov, Lebedev and others much better than by Einstein.**

Other conclusions of the Einstein’s special theory of relativity accepted «ad hoc» as postulates, such as: limiting speed of light, change in the length

during the motion, are not required at all to explain Michelson's experiment, although due to the mathematical and technical difficulties, no way for their direct experimental verification has been found before and after the relativistic epoch.

Consequent manifestation of Newton's theory of gravity replacing the natural motion of bodies by abstract forces of a "pulling" planet hampered substantially the advance of science despite the wide development of our knowledge about the Universe.

Therefore Einstein positively rejected these abstract forces and again replaced the gravitational force by motion putting forward the principle of "equivalence" of gravity and inertia.

Based on this principle, he explained the well-known fact of equal speed of falling bodies, established the equality of inertial and gravitational mass, which until then was of haphazard character, but he could not bind the laws of gravity and electromagnetic field in a single mathematical equation.

After this failure, to solve the properly set problem, he began to develop a theory called a theory of general relativity.

Conclusions of Einstein's general theory of relativity, abandonment of the Euclidean geometry, and introduction of a four-dimensional space-time continuum instead of it, which gave nothing to science, cannot be considered the merits of the general theory of relativity.

After all, we know that long before Einstein, famous scientists – the chemical physicist William Crookes, the zoologist Wallace, the astronomer and physicist Zellner, the famous chemist A.M. Butlerov and others, in order to explain the cycle of matter in which matter is alternately dispersed and compacted, used successfully a four-dimensional space right until the introduction of the "spirits" in science, and by so-called "experiments" tried to prove "the existence of unreal spirits" and establish a certain "regularity" of their appearance and disappearance?

Einstein's theory of four-dimensional space given in "abstract" mathematical equations and in "elegant" schemes, was further developed by efforts of Einstein's followers – Jordan Compton Stronberg, Bogoras-Tan, Heisenberg up to "annihilation of matter", "free will" of elementary par-

ticles, the principle of “uncertainty”. In other words, these scientists are trying to prove experimentally the immateriality of actually existing particles and show that there is no regularity and causality in the world of real microparticles!

Experimental verification of the general theory of relativity, apsidal motion, red shift and deflection of a light beam in the gravitational field known long before the advent of Einstein’s general theory of relativity does not require rejection of the Euclidean geometry, and these laws were developed by Gerber, Soudernsom, Lihodskim well before Einstein, and were adapted by him to his conclusions to explain his theory.

**In view of the above, it should be stated that the general theory of relativity, if the Einstein’s teaching of gravity can be called so, not in the least proved to be correct.**

**And in the theory of the principle of equivalence of gravity and inertia, and in the theory of four-dimensional space, and in the theory of the creation of differential equations of the general theory of gravity, and even in the formula of relativistic apsidal shift, there are contradictions with the theory of the curvature of space.**

Hence it is clear that no unified field theory over which Einstein had been working tirelessly throughout all his life could result therefrom.

Einstein said: “Until there is no unified field theory, there is no physics for me”, and we subscribe to this profound opinion.

We grew up in the time when the fundamentals in science were attributed to Newton and Einstein. This view is clearly expressed in the poem by Pope:

Nature and its laws were lost in the darkness, God said, “Let there be Newton!” And everything lit up.

After the appearance of Einstein, a continuation of this couplet was written:

... “But not for long. The devil said, “Let there be Einstein!” And once again everything plunged in darkness.”

It seems to us that Einstein himself, like a ‘ghost’, sent down from heaven and brought us, “mere mortals”, the special and general theory of relativity. If this can be said with respect to the general theory of relativity not including the four-dimensional space, it will be unfair to the special theory of relativity, for which Einstein derived strength from the scientific heritage of Lorentz, Poincare, Fizeau, Foucault, Euler, Laplace, Thomson, Descartes, N. Umov, Platon, Lebedev, and other physicists – who contributed to a considerable degree to the development of the special theory of relativity, though the roots of all this go deeper into the heart of centuries, to the philosophers of ancient and modern world.

Nevertheless, we cannot deny the role played by Einstein in changing our views.

He courageously opened the floodgates to push a fresh stream «sublime essence» of arbitrary fantasy, divorced from logical thinking and having broken for good all ties with the “intellectual” tradition with its strict laws and causal phenomena, into the real world – the world of reality with its fully justified logical conclusions and so-called “common sense”. Einstein introduced many profound ideas and raised several questions before the physicists of the future.

And if all this is apparently not fated to be further developed and will be replaced by new views and new theories, which was not denied by Einstein himself, it in no way can hide from us his great ideas that will undoubtedly serve a starting point of the whole historical epoch for further development of physics.

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