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> ## THERE IS NO NATURAL PHENOMENON WITHOUT MOTION OF MATTER

> ### FROM A UNITARY ELECTROMAGNETIC MATTER TO A UNITARY ELECTROMAGNETIC SCIENCE OF IT

RATIONAL PHYSICS
WITH A SINGLE
DETERMINISTIC THEORETICAL BASIS

"A crucial prerequisite for the power of knowledge is not the belief in a reputedly infallible authority, but the irresistible power of experimental facts which irrefutably reveal the most reliable authority, Nature itself."

(Life's wisdom)

"Our ideas of reality cannot be final, so we should always be ready to change our point of view, i. e. to change the axiomatic basis of physics so as to substantiate the new experimental data observed by us into a logically most perfect way."

A. Einstein, 1931

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ANNOTATION

Having detected a number of considerable flaws in physics, and basing his research on a profound analysis of well-known yet not accounted for experimental facts, among which some of Isaac Newton's of 1704 and 1718 and of G. Kirchhoff's of 1860, as well as some others from modern physics, which facts prove most convincingly that matter (mass) in the nature (the world) is only electromagnetic, the author brings forth a new theoretical basis of the entire physics. In compliance with the new theoretical basis of physics, the author asserts that:

- gravitational field is a secondary electromagnetic field;
- there exists a unitary theory of motion for objects both at velocities ($v \ll c$) much lower than velocity of light and at velocities ($v < c$) close to velocity of light;
- relativistic electrodynamics results from Isaac Newton's 1704 experimental facts and it explains that mass (matter) of bodies increases along with velocity, since magnetic (kinetic) energy is generated, whose mass is summed with the mass of the object at zero velocity;
- carrier of thermal energy are not only molecules of gas, but photons as well, which are carriers of electromagnetic energy of the photon gas, which photons are emitted by atoms, but there are no photons in atoms, there is magnetic (kinetic) energy, which can convert into photons ;
- and some other new effects.

Some of the flaws, which contradict experiment or have no experimental confirmation, are left out of physics, and they are:

- principle of constancy of the velocity of light *c* relative to an observer, which is disproved by Doppler effect, which was deduced by Einstein as well. ***However, this principle holds true in relation to a source of light, as per Fresnel's law of 1818 – this principle remains;***
- theory of relativity, Lorentz transformations and space-time continuum, which contradict experimental facts;
- de Broglie's waves of a body of mass *m* and velocity *v*, whose energy of de Broglie's waves is $W_B = h.\nu = m.v^2$, where *h* is Planck constant. Since the real energy of the body is $W_R = m.c^2$, the ratio $W_B / W_R = v^2 / c^2 < 1$ (*c* is velocity of light) ***shows that de Broglie's waves are rejected by the law of energy conservation.***

These and others flaws in present-day physics require a correction in the sense of rationalizing its theoretical basis and thence, the whole physics.

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FOREWORD

1. GENERAL FORMULATIONS

This book is an attempt, mainly in qualitative terms, to unite different parts of physics under a theoretical basis, called Principal, on the basis of the uniform and homogenous nature of matter in the form of electromagnetic matter.

This approach, the first of its kind for physics as a unitary electromagnetic whole, is based on the fact that all sciences, including such a leader of sciences as physics, investigate (study) the manifestations (states, in the sense of states of quantities of matter and energy, and states of rest and motion, and of various structural states) of matter. *Provided that matter is homogeneous and electromagnetic, as it results from the writings of Isaac Newton and is shown in this book, it follows that all natural phenomena are genetically homogeneous, i.e. they have the essence of the unitary electromagnetic matter - they are electromagnetic phenomena.* Or at the root of the theories of all natural manifestations (phenomena) are the theoretical basis of the manifestations (states) of electromagnetic matter, called Principal.

Due to the circumstance that the presented attempt to seek unity in all physical phenomena due to the homogeneous matter of nature, is essentially the first attempt in the history of physics, after Wilhelm Wien's ideas of 1900, the emphasis here being mainly on the qualitative aspect of his presentation. Therefore, in the precise meaning, the ideas presented herein may be incomplete or some errors may be found here or there. That is why the author kindly asks his readers to forgive his mistakes and omissions, and to read the book till the end, because it is not until the whole book has been read that some of the omissions could be compensated and a more complete rationale be obtained of the genetic uniformity of natural phenomena in the science of physics.

2. THE ROAD OF THE NEW IN SCIENCE

In [1] (p. 7) we read: In the history of science, it has been not a rare occasion for **scientists to fail to recognize new scientific facts,** *(as is the case, for instance, with Newton's Opticks in 1704 – P. P.'s note)* **even when they emerge before their eyes**. This may happen either because an observer is theoretically unprepared or because there is not a sufficiently developed theory in the store of collective knowledge, ready to assimilate the new observations". (*All italics in this foreword are P.P.'s), or some described experimental facts and theoretical conclusions made by previous researchers have not been given due attention.*

Further, in [2] (p. 129) we read: "The carriers of old ideas and theoretical assumptions will not surrender without fight. That is why new ideas only succeed in establishing themselves after decades or even centuries." The famous physicist Max Planck wrote: "In the 80s and 90s of last century (referring to 19th century – P. P.'s note), I realized how frustrating it feels when a researcher arrives at ideas superior to the dominant ones, for his voice is too weak to make the scientific society listen to him... **The old routines, ideas and assumptions in science, even if they run counter to the new scientific data, are very viable.** They will hardly succumb to reconsideration; this is so because, more often than not, they are bound to a chain of other scientific assumptions. *The process of demolition of outdated scientific views affects the interests and prestige of a wide circle of scientists*, WHO WILL RESIST IN ANY WAY AGAINST THE INTRODUCTION OF THE NEW. Even inadmissible contrivances, very remote from the scientific style, may be used sometimes, such as humiliation or public exposure of the carriers of new ideas. *It is well known that Newton's theory faced the opposition of so authoritative scholars in their times as* **Huygens, Leibnitz, Bernoulli, Euler**, and others."

According to Immanuel Kant, ONE OF THE HARDEST REFORMS IS THE ONE IN HUMAN THOUGHT.

3. EPILOGUE

The author of this book does not believe that the ideas and solutions proposed by him in the book will be readily accepted by the society of physicists, irrespective of the positive fact that *sufficient number of validating experimental (scientific) facts are presented in support*. The author, however, hopes that sooner or later, in one or another form, **these ideas will cut a road through the official academic physical science**.

Most researchers *at first would probably look down upon the author from the heights of the artificially exalted image of infallibility of certain scientists and along with this of the ingenuity of their theories. Or, they might feel sorry for the author, as for a man in a pitiful plight with regard of something in his head.* **What should this author in a pitiful plight do?** *Since it is always possible that some of the ideas of the scientific authorities may be refuted by the irresistible force of experimentally validated facts, BEFORE WHICH EVEN SCIENTIFIC GENII, AS WELL AS GODS, SHOULD KEEP SILENT!*

LITERATURE

1. Methodological Principles of Physics. Academy of USSR, Nauka, Moscow, 1975 (in Russian)
2. I. D. Andreev. Theory as a Form of Scientific Knowledge Organization, Nauka, M., 1979.

PREAMBULE

IT WOULD BE WRONG TO BELIEVE THAT ALL IN SCIENCE IS PERFECTLY WELL-GROUNDED, i.e. proved. There is always some intuitive element in science in the form of assumptions and hypotheses, i.e. a belief in something unproven, which is yet to be proved or disproved by bringing forth new ideas. Or, as Goethe put it, "Brave thoughts (ideas) resemble pawns venturing forward in a game (of chess). They perish in order to ensure victory." I.e. to postulate the true idea behind a discovery means to outline the development of science for years to come, even though afterwards, from the heights of a theory on a permanent making, this idea may seem quite obvious or common.

HOWEVER, UNDERSTANDING A DISCOVERY (BRAVE IDEAS) WILL OFTEN REQUIRE DENIAL OF SOMETHING WHICH EVERYONE HAS CONSIDERED AN OBVIOUS TRUTH.

THERE IS A WONDERFUL EXPRESSION BY DESCARTES (1596 – 1650) „IN ORDER TO KNOW THE TRUTH, WE NEED TO QUESTION EVERYTHING AS MUCH AS POSSIBLE AT LEAST ONCE IN OUR LIFE, I.E. TO MISTRUST WHAT SEEMS EVIDENT BY ITSELF, WHAT PROHIBITS ANY DOUBTS, AND TO SUCCEED IN BREAKING THE VICIOUS CIRCLE OF SO-CALLED TRUTHS, WHICH ARE OFTEN APPARENT ONLY BECAUSE NO ONE HAS EVER MUSED OVER THEM LONG ENOUGH."

SOME EMPHASES,
WHICH SUPPORT THE PREAMBULE IN THE PART
THAT IT IS WRONG TO BELIEVE THAT EVERYTHING IN SCIENCE IS PERFECTLY WELL-GROUNDED

First. Flawed interpretation of Michelson-Morley's experiment (MME). Michelson-Morley's experiment consists in: first of two fixed to each other perpendicular arms $\overline{AO}$ and $\overline{BO}$ of equal lengths ℓ_0, along which propagate light beams from a light source, fixed to the arms and forming together with them the interferometer of Michelson. **I.e. the source of light and the arms are one whole. In this sense, Michelson's interferometer is also source of light in the sense of A. Fresnel's law of 1818 which states:** *"The velocity of light is constant relative to its source, regardless of its state of motion or rest"*. Einstein in the introduction to his article "Zur Elektrodynamik der bewegter Körper" Ann. Phys. 1905, 17, 891 – 921, wrote: "..., namely, that light in vacuum always propagates at velocity c, which does not depend on the state of the emitting body." I.e., he cited Fresnel's law. *In this case, since Michelson's interferometer is also source of light, it follows that velocity of light relative to both its arms is constant and equal to c, and since the arms are of equal lengths, according to Fresnel's law, times t_A and t_B, for which the beams will run along of the arms will be equal*

$$t_A = \frac{2.\ell_0}{c} = t_B = \frac{2.\ell_0}{c}; \tag{1-1}$$

as it is proved by MME as well. This apparent, even at first sight, fact, brings up this question *why this flawed experiment is taught in the courses of physics in secondary and tertiary education.*

Second. Although Isaac Newton in his book, "Opticks or a treatise of the reflections, refractions, inflections and colours of light" of 1704 wrote (quotations are given in a synthesized form compared to the original, P.P.'s note):

„All bodies emit and absorb light"
"Bodies convert into light, and light – into bodies."
"These are normal natural phenomena - facts."

And in 1860 Gustav Kirchhoff proved the empirical law that *„the ratio of energy emitted by a body to the absorbed ray (electromagnetic)* (P.P.'s note) *energy is constant and does not depend on the kind of material of bodies."* **Moreover, Kirchhoff confirmed Newton's experimental facts that matter in nature has the essence of electromagnetic waves, i.e. electromagnetic matter.** Up to this day, no one has paid due attention to the corollary of these experimental facts, which are an unconditional natural law, which states that *matter in the world is homogenous and has electromagnetic essence, i.e. that matter in nature is only and solely electromagnetic.*

These well-known, crucial for science facts have been ignored up to this day, although they have always been available for researchers of physics.

Third. J. Maxwell in "Treatise on electricity and magnetism" of 1873 wrote: in paragraph 636: "Kinetic energy in a unit of volume is $\mu_0 \left[\vec{E}.\vec{B} \right]$ and it exists wherever there is magnetic field, i.e. in all parts of the field." And in paragraph 638 he wrote, "*Therefore, energy of fields consists of two kinds of electrostatic or potential energy and electromagnetic or kinetic energy".*

This quotation entails that when an electron of mass at rest m_{e0} moves at velocity $v < c$ magnetic energy is generated around the electron

$$\text{a) } W_{He} = m_{e0}.c^2 \left[\left(1-\beta^2\right)^{-\frac{1}{2}} - 1 \right]; \text{ b) } \beta = \frac{v}{c}; \tag{3-1}$$

which magnetic energy at very low velocities

$$\text{a) } v \ll c; \text{ b) } \beta = \frac{v}{c} \ll 1; \text{ or c) } \beta = \frac{v}{c} \to 0; \tag{3-2}$$

is described by the simplified formula

$$W_{He} = \frac{m_{e0}.v^2}{2}; \tag{3-3}$$

These magnetic energies (3-1) and (3-3), according to Maxwell, are kinetic energies of electrons. But Einstein in his article „Zur Elektrodynamik der bewegter Körper" Ann. Phys. 1905, 17.891 – 921", where he derived formula (3-1) as kinetic energy of the electron, did not take into consideration that according to Maxwell that was magnetic energy; instead, he called it kinetic energy without explaining that according to Maxwell that was electromagnetic energy. Despite that, Einstein in his article "Autobiographisches" in his book "Albert Einstein. Philosopher-Scientist" of 1945 wrote: "The special theory of relativity arose from Maxwell's equations". And he insisted on that being the expression of kinetic energies of all bodies at velocities

$$\text{a) } v < c; \text{ b) } \beta = \frac{v}{c} < 1; \tag{3-4}$$

This idea (3-1) was assumed in physics for the kinetic energy of all bodies. And the expression (3-3) is derived from (3-1) on condition (3-2) whereby the expression $\left(1-\beta^2\right)^{-\frac{1}{2}}$ is expanded in a power series and only the first two terms of the series are taken and (3-3) is obtained.

The presented above entails a categorical conclusion: kinetic energy of electromagnetic matter is magnetic energy, but in physics no analysis like this has ever been performed, and it should have been, according to Maxwell' electromagnetic theory.

Fourth. Maxwell in „Treatise on electricity and magnetism" of 1873 in paragraph 792 wrote: *"That is why in a medium, where waves propagate, there is pressure in direction perpendicular to the waves and numerically equal to the energy in a unit of volume."*

This law was written in words by Maxwell as a subtitle „energy and pressure during emission". And at density of mass ρ, density of energy w and velocity c of electromagnetic waves, the above law is notated by formula

$$w = \rho.c^2; \tag{4-1}$$

When integrating (4-1) for volume V we have it in the form

$$\text{a) } W = \int w.dV = c^2.\int \rho.dV = c^2.m; \text{ b) } W = m.c^2; \text{ c) } m = \frac{W}{c^2}; \tag{4-2}$$

These regularities are confirmed experimentally by P. Lebedev in 1900 at the congress of physicist in Paris.

Since the law (4-2) results from Maxwell's law (4-1) it should be assumed that the law $W = m.c^2$ **is a law given by Maxwell, although Einstein was the first to announce it, without mentioning Maxwell.**
This fact is not reported in modern physics, although it has been known since 1873 and even has repeatedly been cited by P. Lebedev during and after 1900.

Fifth. In classical physics, according to Newton's "Principles ...", it is assumed that matter in the world is homogenous in essence. Only that in "Opticks ... " it was not called electromagnetic. *In Maxwell's electrodynamics and in the relativistic electrodynamics, however, in particular the special theory of relativity, it is accepted that matter is electromagnetic.* Moreover, the electromagnetic laws of relativistic electrodynamics (mechanics) at very low velocities, condition (3-2), get transformed into laws of classical physics (mechanics). This fact clearly speaks that the homogenous matter in classical mechanics should be electromagnetic, since with both homogenous matter and electromagnetic matter defined as available, there would be a contradiction: one part of matter is homogenous, and the other is electromagnetic, i.e. that there are two kinds of matter. *Therefore, it should be assumed that there is only one kind of matter and this is electromagnetic matter. But despite these facts, even today, modern physics operates with two kinds of matter, which fact is a physical incorrectness.*

Sixth. It *is well known that: a) electromagnetic matter in the form of electromagnetic waves (light) generates gravitational field and therefore is attracted by the sun and b) electromagnetic matter in the form of electrons and positrons with masses at rest*

$$\text{a) } m_{e0} = \frac{\left(\mp q_e\right)^2}{4.\pi.\varepsilon_0.r_{e0}.c^2} = \left(\mp q_e\right)^2.k_m; \text{ b) } k_m = \left(4.\pi.\varepsilon_0.r_{e0}.c^2\right)^{-1}; \tag{6-1}$$

generate gravitational field

$$\vec{G}_E = -\frac{m_{e0}.\gamma.\vec{r}_0}{2} = -\left(\mp q_e\right)^2.k_m < 0; \tag{6-2}$$

where: $\mp q_e$ is the electrical charge of the electron and the positron: ε_0 – dielectric constant of vacuum; r_{e0} – computational radius of the electron and the positron; c – velocity of electromagnetic waves (light) and γ – gravitational constant.

It is also known that the electron and the positron at rest generate electrostatic field E_e, an in motion – magnetic field H_e , which have densities of their masses

$$\text{a) } \rho_E = \frac{\varepsilon_0.E_e^2}{2.c^2}; \text{ b) } \rho_H = \frac{\mu_0.H^2}{2.c^2}; \tag{6-3}$$

where: ε_0 and μ_0 are dielectric and magnetic constants of vacuum.

As it is known, masses m_{e0}, ρ_e and ρ_H generate gravitational fields

$$\text{a) } \vec{G}_{e0} = -\frac{m_{e0}.\gamma.\vec{r}_0}{r^2}; \text{ b) } \vec{G}_{\rho_E} = -\frac{\rho_E.\gamma.\vec{r}_0}{r^2}; \text{ c) } \vec{G}_{\rho_H} = -\frac{\rho_H.\gamma.\vec{r}_0}{r^2}; \tag{6-4}$$

These facts show that in modern physics it has been proved (known) that electromagnetic matter in substantial and field form (electric and magnetic fields) generates gravitational fields. However, this remarkable fact has not been paid due attention by researchers. These gravitational fields in essence are always positive and have electromagnetic essence, but the functions of the squares of the electrical

charges $\left(\mp q_e\right)^2 > 0$ are always positive so these gravitational fields are unipolar. And here they are called secondary electromagnetic fields unlike the familiar electric and magnetic field, which are proportional to the first power of the electric charges and therefore are bipolar - negative and positive.

By calculating the gravitational energies of the gravitational fields, generated by the electron at rest with mass $m_{e0} = q_e^2.k_m$, its electrostatic field $\vec{E} = \dfrac{q_e^2.\vec{r}_0}{4.\pi.\varepsilon_0.r^2}$ and its magnetic field

$\vec{H} = \varepsilon_0\left[\vec{v}.\vec{E}\right] = \dfrac{\varepsilon_0.v.q_e.\left[\vec{v}_0.\vec{r}_0\right]}{4.\pi.\varepsilon_0.r^2}$ respectively and from the electromagnetic waves.

we have the density of gravitational energy

$$w_G = \frac{G^2}{2.\gamma};$$ (6-5)

Proceeing from the density of gravitational energy, we obtain the densities of the gravitational energies, which are generated by:

a) the mass of the electron at rest

$$w_{Gq} = \frac{m_{e0}^2.\gamma}{2.r^4} = \frac{q_e^4.k_m^2.\gamma}{2.r^4} = K_{q0}.\frac{q^4}{r^4}; \quad K_{q0}.\frac{k_m^2.\gamma}{2};$$ (6-6)

b) the density of the mass of the electric field – of electromagnetic waves

$$w_{GE} = \frac{\rho_E^2.\gamma}{2} = \frac{\varepsilon_0^2.E^4.\gamma}{4} = \frac{\varepsilon_0^2.r_e^2.\gamma}{4.\left(4.\pi.\varepsilon_0\right)^4.r^4} = K_{E0}.\frac{q_e^4}{r^4}; \quad K_{E0} = \frac{\varepsilon_0^2.\gamma}{4.\left(4.\pi.\varepsilon_0\right)^4}$$ (6-7)

c) the density of the mass of the magnetic field – of electromagnetic waves

$$w_{GH} = \frac{\rho_H^2.\gamma}{2} = \frac{\varepsilon_0^2.H^4.\gamma}{4} = \frac{\mu_0^2.\varepsilon_0^4.v^4.q_e^4.\gamma}{4.\left(4.\pi.\varepsilon_0\right)^4.c^4.r^4} = K_{e0}.\frac{q_e^4}{r^4}; \quad K_{H0} = \frac{\mu_0^2.\varepsilon_0^4.\gamma}{4\left(4.\pi.\varepsilon_0\right)^4};$$ (6-8)

The respective gravitational energies are:

a) gravitational energy of electron

$$W_{Gq} = \int_{r_{e0}}^{\infty} w_{Gq}.dV = \int_{r_{e0}}^{\infty} K_{q0}.\frac{q_e^4}{r^4}.4.\pi.r^2.dr = K_{q0}.\frac{q_e^4}{r_{e0}} = K_q.q_e^4; \quad K_q = \frac{K_{q0}}{r_{e0}};$$ (6-9)

b) gravitational energy of electric field E of the electron and of electromagnetic waves

$$W_{GE} = \int_{r_{e0}}^{\infty} w_{GE}.dV = K_{E0}\int_{r_{e0}}^{\infty} \frac{q_e^4}{r^4}.4.\pi.r_r^2.dr = \frac{K_E}{r_{e0}}.q_e^4; \quad K_E = \frac{K_{E0}}{r_{e0}};$$ (6-10)

c) gravitational energy of magnetic field of electron at velocity v and of electromagnetic waves at velocity c

$$W_{GH} = \int_{r_{e0}}^{\infty} w_{GH}.dV = K_{H0}\int_{r_{e0}}^{\infty} \frac{v^4.q_e^4}{r^4}.4.\pi.r^2.dr = K_H.v^4.q_e^4; \quad K_H = \frac{K_{EH}}{r_{e0}};$$ (6-11)

From the presented above, it is evident that the gravitational energy of the electron and of its electric and magnetic fields (as well as of the electromagnetic field of electromagnetic waves) are electromagnetic energy. T_his is another motivation of the argument that the gravitational field is an electromagnetic field, proven by facts, known in modern physics but so far unnoticed._ ON THE OTHER HAND, THE FACT THAT ELECTROMAGNETIC MATTER GENERATES GRAVITATIONAL FIELD IS ALSO A PROOF THAT UNITARY MATTER OF THE WORLD IS ONLY ELECTROMAGNETIC.

Seventh. A. Einstein's observations expressed in various articles, as follows:

1. In [1] he wrote: "It cannot be claimed that these parts of the general theory of relativity, which are now considered to be complete, make a complete and satisfactory foundation of physics."

2. In [2] he wrote: "In order to finish the foundations of the general theory of relativity it is necessary to introduce in it electromagnetic field as well, which, according to our present ideas, is the material out of which we are to build the basic entities of matter."

3. In [3] wrote: "For example, according to our modern views, in their essence elementary particles are nothing but thickened electromagnetic field." And further he wrote:

"Of course it would be a major step forward if we could unite gravitational and electromagnetic field into one picture. Then the epoch of theoretical physics, which originates from Faraday and Maxwell would be appropriately completed.

4. In [4] he wrote: "The purpose of my work is to simplify the theory and, in particular, to reduce it into a formula, combining gravitational and electromagnetic fields", and further on he wrote:

"Now and only now we know that the forces, which move the electrons in ellipses around the nuclei in the atoms, are the same forces, which move the Earth along its annual path around the Sun and also that they bring us the light rays and heat, which make life on our planet possible. "

5. in [1] wrote: „We have to admit that physics does not have common theoretical foundations, i.e. it lacks a logical foundation."

Literature to Einstein's observations:

1. A. Einstein. Considerations concerning the Fundaments of Theoretical Physics. Science. 1940, 91, 487 – 492.

2. A. Einstein. Grund gedamken und Probleme der Relativitätstheorie in Nobelstiltelsen les Prix Nobel en 19221 – 1922" Imprimerie Royale, Stockholm. 1923.

3. A. Einstein. Ather und Relativitätstheorie Verlag von Julius Springer. Berlin. 1920.

4. A. Einstein. Zur Einheitlichen Feldtheorie. Sitzunbericht preass. Akad Wiss. Physs-math K1, 1929, 2 – 7.

Eighth. Nobel Laureate Richard Feynman, Professor in quantum mechanics, wrote in his book "The Character of Physical Law", Cox and Wyman Ltd. London. 1965

1. In Lecture 1 he wrote:

"Today our theories of physics, the laws of physics, are a multitude of different parts and pieces that do not fit together very well. We do not have one structure from which all is deduced; we have several pieces that do not quite fit exactly yet."

2. In Lecture 2 he wrote:

"As long as physics is incomplete, […] we are trying to understand the other laws".

3. In Lecture 3 he wrote:

3.1. "If we put across the variety of these detailed laws there sweep great general principles which all the laws seem to follow."

3.2. "If you thought before that science was certain - well, that is just an error on your part."

4. In Lecture 6 he wrote:

"I think I can safely say that nobody understands quantum mechanics."

5. In Lecture 7 he wrote:

5.1. "I will tell you a little, then, about the stuff on which all of these principles are supposed to have been working. First of all there is matter - and, remarkably enough, all matter is the same."

5.2. "If we put all these principles together, we discover that there are too many. They are inconsistent with each other."

5.3. "But all the principles that are known are inconsistent with each other, so something has to be removed."

5.4. "At least in the past it has always turned out that some deeply held idea had to be thrown away."

5.5. "I believe that it has to be given that certain things exist - not all the 50-odd particles, but a few little things like electrons, etc. - and then with all the principles the great complexities that come out are probably a definite consequence."

5.6. "We have to find a new view of the world that has to agree with everything that is known, but disagree in its predictions somewhere, otherwise it is not interesting."

CONCLUSION

This is part of the known facts in modern physics, which are inconsistent with physical reality and which require rationalizing, both of its theoretical foundations and of physics as a whole.

METHODOLOGICAL ESSAY

1. SOME FEATURES OF THE REQUIREMENTS
ON SCIENTIFIC REASONING

It is known that science does not construct images mirroring natural facts (reality), but it constructs models of them which are simplified (idealized, abstracted) by means of simplified (idealized, abstracted) notions in conformity with the purpose (task) of a specific scientific research. In this way a model is created containing only the most essential (important) major properties (manifestations) of reality (natural facts, obnjects) depending on the purposes of study.

The notion of natural fact or reality should be understood as something material (in a field or substantial form of matter or both), which can be perceived (sensed) directly or indirectly through human senses. *The notions of these realities, perceived by humans, after certain interpretation assumes the rank of scientific facts, expressed through relevant notions.*

It should be emphasized, that the realities always (immutably) have the physical property of quantity (quantitative relations) which are the subject of mathematics. Because of this circumstance, mathematics can describe, in the language of quantities (quantitative relations), the phenomena (processes, objects) of all sciences, which deal with (use) only strictly simply defined quantities in the form of relevant notions.

The thing that generates diverse realities (natural phenomena, nature) is called matter. It is the carrier and generator of realities and is synonymous to the notion of nature. *When studying the realities (natural manifestations, including those of humankind as an element of nature),respectively matter, or rather its manifestations,* **matter is always the initial principle and logical point of support in the conceptual interpretation of the diversity of facts (manifestations).**

THAT IS TO SAY THAT MATTER, IN SUBSTANTIAL ASPECT, AS THE CARRIER BOTH OF ITS ETERNITY – THE PRINCIPLE OF ITS CONSERVATION – AND OF THE TRANSIENCE OF ITS STRUCTURES (ITS MUTABILITY) – THE PRINCIPLE OF ITS INTERACTIONS, I.E. THE LAWS OF MATER MANIFESTATIONS (PROCESSES) ARE EXPRESSION OF THE LAWS OF THEIR LOGIC IN THE NEVER-CEASING ALTERATION OF ITS MANIFESTATIONS IN TIME AND SPACE – IN THE NATURE. Therefore, when studying parts of nature (individual objects – manifestations) as well as nature (matter) as a whole, matter manifests in a way for which there are natural conditions, i.e. *first and above all, conditions should be accounted for and they should be the explanation of some or other manifestations and statesof matter, subject to respective laws.*

In the meaning of the aforesaid, matter is not a metaphysical body, but a unity – a complex of its diverse facts (manifestations) or a complex entity in a field and substantial form: a material continuum.

It should be noted that the two abstracted notions of matter, mass *m,* and its property, energy W, do not exist as separate quantities. *They are always inseparable from each other, because energy is an attributive property of the conceptual (complex) notion of matter, whose abstracted notion is mass, and that is why matter and energy cannot exist separately from each other.* Matter and energy, according to physics, are related to the velocity of light '*c*' through the regularity,

$$W = m.c^2 ,$$
(1-1)

which is universal. And **always, when it is spoken of energy W, unconditionally should also be considered the fact, that it has a carrier, a corresponding quantity of matter, or mass *m*.**

$$m = W / c^2 ;$$
(1-2)

and vice versa, when matter is meant, it always goes alongside with energy, i. e. matter as a synonym of nature, in the methodology of knowledge (scientific studies, sciences), should be considered as a tentative abstraction (theoretical construct) of the carrier and generator of the commonest in the diversity of objects: their property of materiality, which characterizes their unity and reality. *Or matter is the only groundwork and initial qwuantity (basis), as initial resource, which is the carrier, source (cause) of the realities and all natural phenomena (objects, manifestations) in nature.*

The above statement contains the scientific belief and creed of the author of this study – this scientific creed has its fundamental thesis, as follows:

The initial principle of knowledge about nature as a unitary system and about its specific facts (objects, manifestations) as well as of the criterion of veracity and reliability of knowledge is the experiment - practice. *This thesis is based on the idea that each natural reality (manifestation) is material, i.e. that there is no reality that could not be perceived by the human mind, by means of our senses (directly or indirectly), and by means of our logical thinking. And experiments, and practice, are realities.*

The notion of reality should be understood as something material (in a field or substantial form of matter or both), which can be perceived (sensed) directly or indirectly through human senses. The notions of these realities, perceived by humans, after certain interpretation assumes the rank of scientific facts, expressed through relevant notions.

It should be pointed out that realities always (irrevokably) have the physical property of quantitative relations which are the subject of mathematics. Because of this circumstance, mathematics can describe, in the language of quantities (quantitative relations), the phenomena (processes, objects) of all sciences, which deal with (use) only strictly simply defined quantities in the form of relevant notions. Therefore, philosophy cannot use the language of mathematics – philosophical notions are not strictly defined – they are too flexible.

In the aspect of the above thesis, the primary purpose of science (scientific study) is to unite the vast diversity of natural manifestations using sme common properties into one whole system as an expression of the unitary science of nature, called naturology (nature science), which should combinethe following properties (features):

First - it should have a genetically unitary material essence;

Second – it should have hierarchical order of its cause-and-effect relations;

Third – it should reflect the fact that the Universe is in its essence a homogenous material continuum of substantial and field forms of matter (natural phenomena), **i. e. that there is no place in the nature without matter in a field or substantial form. And more specifically, there is no place without a gravitational field and photon gas (electromagnetic fields)**;

Fourth - it should reflect the fact that matter itself (the material continuum) is the carrier and generator of its own manifestations (Natura causa sui est - Spinosa);

Fifth - that *in human mind (brain) there is nothing else real than that, which was perceived through the senses or human thought, as a reflection of natural phenomena or of human thoughts.* Due to this fact (reason), it is only the aggregate sum of these reflections that forms the initial resource (raw material) of forming, via processes of thinking, i.e. by means of internal cerebral material processes of interaction. between material carriers of images, of laws about realities, which are an expression of the knowledge – the truth about the world;

Sixth - that matter, which is the carrier and generator of natural manifestations, is not a compact object (fragment) in the form of metaphysical body, but a complex entity of its diverse manifestations (states) in space and time, i. e. a mentally idealized (abstracted) object. Or *matter is the primary initial logical point of support in conceptual interpretation of reality.*

In this form and meaning as a conceptual notion, matter is the only primary and initial (starting) basis (notion, idea) for forming (constructing) of a scientific view of nature and its parts (fragments), since all studied phenomena and their laws are product of matter. I.e. only if matter is homogenous in essence, can there be a unitary science of nature.

In this aspect matter is not inactive (passive), but active because it carries in itself the active principle called the reason of its own conservation (existence) and evolution.

Seventh – the veracity of the truth of the scientific claims (thoughts), in the form of inferences and laws, definitions and principles, can only be proved by relevant supportive experiments and facts (empirical regularities), *i. e. that no non-empirical (apriori) truths or sciences exist, but all sciences use (are basically product of) the principle of observation of material manifestations - experimental data, i.e. the principle of observation.*

The above idea is grounded in the circumstance that experimental data have the status of irresistible strength of proof or that they have the status of an irresistible proof – ranking to a principle and argument for reliable information and truth. **That is to say that the material experiment is a material expression of the logic (truth, regularity) – the logical necessity –** of the reliable, veracious idea about the essence of the relevant natural fact in dynamic aspect. *Moreover, regardless of whether we want it or not, the experiment is*

imposed on us as an unconditional irresistible natural truth. And *that is why the experiment is a logical point of support for evidence and inferences from natural truths - logical laws.* And the summarized inferences from the experimental data are the beginning (the root) of theoretical inferences (laws), which, *when they are more comprehensive, are called principles* – and the system of them is called logic, and they always have an empirical basis, i. e. a material origin, **because there is nothing of which it is claimed to have real laws which is not material, i.e. this thing is not an expression (direct or indirect) of a specific reality.**

In support of the above reasoning come some maxims, such as:

- *"Even gods remain speechless before facts"* or, paraphrased *"Even genii concede to scientific facts"*;
- *"Facts have an irresistible strength of proof"*;
- *"***True is only that idea which has an analog in nature" - Aristotle***;*
- *"Science is an offspring of experiment"* – *Leonardo da Vinci (1452 -1519);*

Eighth - the theoretical or logical laws (the logic), are applicable for reliable interpretation only in thoughts (claims), which are reliable (experimentally validated) truths (facts) about natural phenomena. Otherwise, when interpreting unreliable truths by logical laws (logic) we will derive non-truths. The reason for this requirement (property) of logical laws (the theoretical foundations) is the circumstance, that they are only generated by (are product of) real (reliable) natural phenomena.

Here we should emphasize the fact that, in general, all laws are logical laws, because they are an expression of truth - of the essence of the relevant natural phenomenon (manifestation) - of an empirical fact. In this sense, the essential meaning of the notions expressed via the terms - *law, logic, principle and truth are synonyms*, which validate the reliability of the relevant empirical regularity manifesting itself in a relevant experiment. *In practice, the term logic (logical) is most often used about more comprehensive and more general, yet reliable, experimentally confirmed, regularities.* While the term law is used for specific explicit manifestations.

Brief systematization of paragraph 1.

1. Science studies the manifestations (states) of objects of homogenous matter out of which is formed the material continuum, which synonymous to the notion of nature.

2. Science does not construct mirror reflexions of natural facts, but simplified (abstracted) models of abstracted notions of the parts of nature, which are essential for the purpose of studies. I.e. models refer to cut-off parts of the material continuum – the nature.

3. The abstracted notion of a quantity of matter is the notion of mass.

4. The notion of energy is another abstracted notion of the notion 'matter', or of its essence (its manifestation) to move and get restructured into various structural forms and states, which is also understood as a material manifestation, reflecting the possibility for material objects to move and restructure from one structural state into another.

5. The model of a unitary science of nature (material continuum) is a system of models of natural facts, which are structural elements of the system (unitary science – naturology), which reflects the manifestations of the regularities of the material continuum.

6. The initial principle and criterion of the reliability of scientific models are experimental facts, which are an expression of the material regularities and are logical laws.

2. SOME METHODOLOGICAL DEFINITIONS

2.1. On the notions of explicit and potential (implicit) properties

Explicit properties (manifestations) of parts, systems of parts or of nature as a whole are only these properties, for which there are or there have been conditions (situations) when they are in the form or condition where their existence can be observed and they can be registered as observable.

And those regularities (properties) of the objects (parts, systems or of nature as a whole), for which up to this moment there have not been proper conditions to manifest themselves as explicit are called potential (implicit, non-observable) laws (properties). And they are such until the moment when conditions arise for them to become observable.

The number of the potential regularities (properties) of each object is unknown, and because of this fact, an indeterminate number of notions for diverse properties (manifestations) of object (the system, the

nature) can be formulated from their unknown number. Or by the notion of diversity or diverse manifestations it should be understood that if there are *n* known (explicit) diversities of an object, then there always exist $m > 0$ more potential (unknown) diversities.

For example, Newton's mechanics, which was developed without the field form of matter, was without the potential property of field matter. Whereas Maxwell's electrodynamics is based on explicit field property of matter of electromagnetic fields. And **thus, the discovery of the potential properties of an object as explicit ones may lead to new theoretical inferences.** *Therefore, the availability of potential properties leads us to the conclusion, that any new theory can always be the last but one word (theory) in its respective scientific area.*

The purpose of scientific research is to discover and describe as explicit those properties which have been potential (implicit).

2.2. ON THE SYNONYMY OF THE NOTIONS OF SCIENTIFIC, THEORETICAL AND LOGICAL

The theoretical foundations (regularities) as well as the logical foundations (laws) - the logic of sciences - start forming (amassing) themselves in the human mind from a human being's birth to the end of his conscious life in the form of experimental resource, through observation and mental activities (education, media (radio, television), literature, etc.). This is actually the initial logical resource (product, raw material), which is then processed by the material mental process in the brain so that new truths (logical inferences) may be deduced as the scientific resource of science (study). *Due to the presented above, there is no place here for any non-material activities brought into scientific studies via the notion of apriori, i.e. something before the experiment.* Since there is no real assertion that is something true if it is not about a material reality (natural fact) – there is not anything and there cannot be anything which, being generated in reality, was not generated by something material.

In the above sense, self-evident are the following truths:

First - that there are no laws, which are not logical, as long as they meet the requirements of a reliable, experimentally validated truth, which has an analog in nature.

Second - that there is no natural fact (object), whose properties (regularities) are all known (explicit); due to which the number of its diverse manifestations is not known.

Third – the preceding two truths imply that it is impossible to give a complete (exhaustive) description of a natural fact, but only a simplified model of the relevant reality of nature can be given (without its potential and other properties).

Fourth – in scientific studies, the following essential points should be taken into consideration:

1) Each real thing in nature, which is perceived through senses, is material;

2) The notion of matter is a specific synonym of the notion of nature;

3) *The initial (raw-material) resource of notions (ideas) in the human mind (brain), out of which we form inferences (truths) about nature as a whole and about its parts, are only the images of natural phenomena reflected in our brain, through our organs of senses plus the resources of human brain and nervous system* . Out of these images, after a relevant interpretation, we can create relevant scientific facts (notions) - SF (SN), which are the initial scientific resource.

Scientific facts have irresistible strength of proof, similar to that of Archimedes' point of support, because their beginning (the root) is in the experimental data, and this fact is an expression of the logical necessity for the natural phenomena;

4) *Science (theory) is not a mirror reflection of natural phenomena, but only their schematic image (model) by means of abstracted notions of the parts reality - nature.* **Depending on the purpose of a study, the abstracted (simplified) notions always reveal some flaw (incompleteness) relative to their relevant physical (chemical or biological) reality.**

5) From point 4) the categorical statement (conclusion) follows, that **every scientific theory (achievement) in a certain natural field is only the last but one word in this field.** *Which means that scientific advance is unlimited, i. e. it is boundless, because every new achievement can be followed by another one, which has been potential up to the moment, i. e. this is a mathematically endless process.* *This means that* <u>SCIENTIFIC ADVANCE IS UNLIMITED – IT IS ENDLESS.</u>

2.3. Some aspects in the science as a unitary whole – the science of nature

2.3.1. The fact of the incessant alteration of natural occurrences entails the law that there exists and incessant development of science (knowledge of nature). And also that **due to this circumstance we should always be ready to alter our scientific ideas about natural occurrences by new, more perfect in compliance with the new facts in experimental and logical aspects.**

2.3.2. With the advancement of science, our ideas about fundamental laws get more simplified and summarized, and thus the theoretical foundations of science become more simplified and more perfect deductive principles.

2.3.3. The ultimate task before researchers and scientists is to discover the basic initial laws (deductive principles), out of which, by means of a unified approach, starting from an initial principle, to explain (describe) all natural occurrences (manifestations), and thus to unite all sections of physics under unitary fundamental laws – the theoretical basis (logical foundations,) the common deductive principle, which is called here Principal.

2.3.4. The task of this book, probably the first more comprehensive attempt, in aspect to formulate and develop the directions of physics as an expression of a unitary genetic principle in the evolution of nature (the world) and concurrently, to postulate the initial scientific factor for studying and constructing the theoretical foundations of the science of Universe, treated as a whole, which is called here Principal, as well as of its details, which are studied by specialized sciences – components of the unitary science of the nature – called naturology, all resulting from the Principal.

2.4. On the approach (method) of attaining new knowledge

2.4.1. General formulations

The purpose of science of nature as one whole is to unite all natural diversity under a common indicator, which should be a universal principle. Based on such an indicator of universal validity, which the author assumes to be the principle of uniformity of the essence of matter, i.e. all the diversity of natural facts (objects, phenomena, processes, etc.) in mineral (dead) and living matter are formed out of the same (homogenous) initial resource.

Provided the homogenous essence of natural factsis proven, a model of a unitary science of nature as one whole should be made. This model should essentially be a system of homogenous structural elements of different structures, which are specific models of abstracted notions of diverse natural facts.

For such a model to be reliable, it should meet the following initial formulations.

First. All scientific truths (knowledge) should be models of homogenous matter. They should be constructed out of abstracted notions, which reflect not only the uniformity of their resource (matter) but also their specificities depending on their structural states, in space and time. I.e. the model of the science of naturology should be made out of the models of specific (specialized) sciences, which are components (structural elements) of the system (model) of naturology.

Second. The initial (starting) deductive principle (theoretical basis or logical foundation) of naturology should be valid for specific sciences as well, but they should also have their specific (particular) components of their deductive principles, which essentailly are secondary principles. In this sense, specific sciences have a broader spectrum of deductive principles, while retaining the same homogeneity as that of naturology. The motivation for this statement is the circumstance that knowledge is a generalized idea of the manifestations of a unitary in its essence matter.

Third. The realization of the two preceding formulations would be a realiable truth (scientific fact) only with the unconditional proof that matter is homogenous in essence, and its diverse manifestations in the form of natural facts result from their diverse structural, quantitative and organizational forms (states).

*Emphasis. In his mechanics, I. Newton deduced the initial laws only by summarizing experimental facts, without discussing the essence of matter, of which he introduced the abstract notion of mass. **But the fact that matter is the motivation of all mechanical manifestations in nature, respectively of all natural laws, entails the inference that Newton considered that matter was of homogenous essence.** That idea of Newton's is also confirmed by the fact that in the theory of gravitation he did not take into consideration any influence of the essence of matter when the force of attraction is generated either of bodies, or of light (electromagnetic matter). That is why he wrote in "Opticks" of 1704 that bodies attracted light.*

Besides, in his book „Opticks..." of 1704 he wrote that gravitational, electrical and magnetic forces act with all bodies, which circumstance is only possible with homogenous matter.

2.4.2. On the method of formal logic – MFL

The approach for attainment of new truths (knowledge) was formed in Antiquity in the fourth century B.C. by Aristotle, who summarized knowledge of nature under the term of philosophy of nature.

Aristotle asserted that new truths could only be derived from known truths, i.e.

First. *We should proceed from a system of known truths, which system he called a prerequisite. This prerequisite, in Euclidean geometry – EG, is called a system of axioms (truths).*

Second*. After making a logical analysis of the prerequisites (the system of known, reliable truths), logical inferences (laws) are deduced, which in EG are called theorems.*

Third. The inferences are correct (reliable inferences), if they have analogue in nature.

Apparently, this approach of Aristotle, which in philosophy is called method of formal logic, is applicable to all sciences. Mathematicians, claiming that their science, mathematics, is the initial principle for all sciences, point out, without calling it MFL, that this method is mathematical logic. But historical facts disprove them.

Here it should be noted that, although Aristotle stated that inferences (laws) should have their analogue in nature, i.e. they should have experimental validation, he personally, and other scientists after him, did not firmly adhere to the experimental validation, since Galileo disproved it with reference to the claim that heavier bodies fall faster during his experiments from the leaning tower of Pisa.

In general, Galileo introduced into modern sciences the abstracted notions, the inferences by means of MFL and the experimental confirmation of the inferences.

3. ON THE UNITY OF NATURE AND OF THE SCIENCE ABOUT IT

3.1. General formulations

*„The principle of unity of the science about nature, whose subject is nature as one whole, as Max Planck put it, has its root in Antiquity, i.e. since ancient times, for as long as studies of nature have existed, this ideal has always stood as a task of highest rank****: to unite the multitude of diverse phenomena into one system, and if possible, into one only formula".***

As R. Feynman wrote: „The purpose is to understand the phenomena in all nature as manifestations of one common source. The aim is to find out the laws, lying behind experiment and uniting these phenomena".

The thesis of unitary essence (uniformity) of the knowledge of the nature as one whole, is synonymous to the uniformity of the manifestations of the unitary matter and of the unitary science of it, which can be called naturology or science of nature. I.e. this science should have the nature as one whole for its subject. The motivation of this thought is the fact (circumstance) that in all history of science, knowledge has accumulated as an expression of general interpretations of experimentally discovered manifestations (states) of matter, because which it is assumed to be of homogenous essence.

The notion of matter should be understood not as a metaphysical body, but as a mentallty idealized object, which is an integral carrier of the common general primary (regularities) of all natural facts. **And the carrier and generator of these common primary properties of matter is the initial (starting) homogenous resource, which is called substance or substratum of matter.** *That is to say that substratum (substance) of matter implies the initial homogenous homogenous starting resource, out of which it was created.*

In this definition of the material unity of natural phenomena, is also the objective basis of the unity of the science of nature, i.e. the unity of knowledge about nature as one whole is generated by one homogenous in essence primary initial resource. ***The notion "essence of something" should be understood that this is one or more real major features of this thing in the form of unequivocal primary properties, which are unmutable and durable features, which characterize some quantitative definiteness of this thing.*** In this sense, the essence of this thing is determined by its internal contents and external manifestations. This means that its features and the organizations of its structural[*] elements are important.

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[*] By structure of matter should be understood the spatial distribution (by place and density) of the structural elements of the thing (the substance).

By organization of matter should be understood the sum total of all movements of the structural elements and forces that ensure its motion within a certain volume (finite motion) in order to conserve the respective dynamic structure.

This statement is based on what Max Planck wrote: „Science is an internal unitary whole. Its division into individual fields results not from the nature of things, but from the limited human capability to summarize knowledge. In actual fact, there exists a continuous chain, from physics and chemistry through biology and anthropology to social sciences. A chain, which cannot be broken in any of its links, unless at random."

The scientific fact, which is interpretation and summary of experimental facts, serves as a reference point, and is a startard for the logical constructions of the laws out of which are formed its theoretical foundations.

Emphases
Nobel Prize in Physics Laureate R. Feynman in his book „Feynman's Lectures" claimed that till that day it was not known what energy was.

However, in this aspect, as a counterbalance, two significant facts can be pointed out.

First emphasis
There is a law of energy and mass conservation, i.e. energy and mass are eternal.

This law entails the categorical fact that energy is something made of matter, because only material objects can be said to be conserved, or more specifically that their matter can be conserved.

This fact implies that energy is a manifestation (property) of a real (explicit) or potential structural state of homogenous matter of the World.

Second emphasis
The other inference from the above law of conservation is the categorical claim that energy in the world, as one whole, is solely and only homogenous. **The motivation of this claim is the circumstance that if energy were diverse in essence, there would not be (theer would be a contradiction to) the law of its conservation, because it would not be clear for which of the diverse energies the law of energy conservation holds true.** The real and permanent existence (the law of conservation) of energy is the motivation to assert that it is something real and material, i.e. that energy is a material object with mass – quantity of matter, because only about something made of matter can it be claimed that it is mass. And this quantity of matter (energy) has a respective structure depending on conditions. ***However, energies must be only of homogenous essence, for, if they were not homogenous, the law of energy and mass conservation cannot hold true.***

The fact of the homogeneity of energy, which is inseparable from mass, respectively from its homogenous matter, ***means that energy is a manifestation of the homogenous matter itself, i.e. energy is an expression of the respective state of matter –there is no energy in a separate (independent) state without matter (mass), it is a state of matter, which generates motion and performs work***. In this sense the expression "does work' means a process of restructuring of the unitary matter from one state into another, i.e. this term 'energy' is synonymous to the expressions „process of restructuring of matter" or „performing work", whose meaning is the same in the issue under question.

Therefore, energy is matter, which is studied in a state of restructuring, and homogenous in essence, and matter is eternal.

These facts, after it has been assumed in physics that there are magnetic, electrostatic and gravitational energies and masses, entail that in science they are homogenous. And indeed, they can be generated in the form of genetically homogenous, only of homogenous in essence, elementary particles electrons (electron and positron). In this sense, the fact that are generated from homogenous in essence elementary particles and antiparticles, is a proof that they have homogenous genetical principle, i.e. they are genetically homogenous.

The thesis of the homogeneity (homogenous essence) of nature and that it is one homogenous whole, which is synonymous to the unitary matter (material continuum) predetermines the availability only of one unitary science, a science that is one whole and so it should be called Naturology. The motivation for this are:

a) *Science of nature is unitary (one whole) for it is a fact that science studies the essence, the states and the manifestations of unitary matter, both the one whole and its parts, which have relative independence;*

b) *The name, Naturology, results from the accepted principle that science about the manifestations of a certain subject should be named by a term, which includes the name of the subject. Most often this name is of Latin origin and ends in „logy".*

The scientific study of the scientific manifestations of the parts of the whole (nature, material continuum) by specific sciences, which are carriers both of the general scientific principle of the manifestations (properties) of the whole, and of the specific features (properties) of the part, which is reflected by the whole, i.e. a specific science is a science about the manifestations of an object, which is part of the nature.

Under these conditions, it is evident that before determining the specific scientific features of the parts of the whole, it is necessary to study and find out (discover) the main features (regularities) of the whole. This thought is grounded in the circumstance that the specific features of the object, which is part of the whole, result from the features of the whole plus additional (specific) features of the cut-off part of the whole, bent by (adapted to) the specific situations (conditions), in which the object is studied as a cut-off part of the whole.

That means the the features of the initial resource in scientific studies determine the primary attributive properties of the part cut off the whole (the object), and the structural and organizational states, through which the resource manifests itself, depending on the conditions, in which the object is placed, determine its specific features.

Quite often researchers neglect the fact that the object is part of the whole – the nature. And so they do not take into consideration some of the features of the whole and treat the object as something entirely independent. This circumstance as a common practice with researchers, makes it more difficult to descry the unity of nature and of the science of it.

Here is a typical example of how a scholar of great erudition and laureate of Nobel Prize Prof. R. Feynman missed to discern the genetic unity between electromagnetic and gravitational fields.

In his book "The characters of Physical law" Coxand Wyman Ltd. London 1963 Professor R. Feynman in lecture I "An example of natural law - the law of gravitation" on p. 31 of the translation of this book from Russian , ed. Mir, 1968 wrote:

„So far nobody has been able to present gravitation and electricity as two different manifestations of the same reality".

Prof. Feynman himself in his book „Feynman's lectures in physics", which was published about two years before „The character..." **wrote on the gravitational interaction between the electron and the proton."** And before this interaction, he wrote in „Feynman's lectures..." **about the electric and magnetic fields and energies generated by the electrons (electrical charges)".**

This comes to show how a famous scientist (Professor Feynman) in one of his books wrote that one and the same reality (the electron) generates electric and gravitational field and energies. And in another book, after the first, he wrote that no one has been able to present electricity and gravitation as manifestations of one and the same reality.

This absurd situation, is a real fact about a renown scholar.

This fact is in support of Rene Descartes's thesis that no scientific claim should be given credit before we have made sure that it is a reality which has experimental confirmation.

3.2. Is matter of genetically homogenous essence

3.2.1. General formulations

When it is alleged that nature is a whole, this means that it generally is formed by something that is homogeneous, i.e. something that is a homogeneous natural resource, which is called homogeneous (uniform) matter. And scientific truths that have experienced confirmation reflect properties of the unitary mater in the form of models of abstracted notions of the parts which are here called natural facts. This means that the models are expression of the properties of the cut-off parts of the whole – unitary matter which is synonymous with the concept of matter.

In this sense the law follows that the parts are carriers of two properties different by their media, such as:

a) the general properties of matter (attributive properties) - nature as one whole;

b) the specific properties (structural properties) of the severed part of the whole, i.e. the material continuum.

The above law entails that to the whole unitary and homogenous matter in nature correspond the fundamental principles – the single deductive principle (logical foundation, theoretical basis) of the science of nature, regarded as one whole, which here is called Naturology. *And this single deductive principle is in the base of the deductive principles of the specific (concrete) sciences, which have as their subject the individual parts (natural facts).* Therefore, the specific sciences are diverse components of the diverse (specific) manifestations of natural facts formed only from one homogenous resource.

Emphasis

Only when nature is interpreted as a system of parts (natural facts) connected in one whole, can the basic laws (principles) of the connections (mutial relationship) between them and the whole be revealed in full. *It is exactly their integral unity and the principles of the whole system (the nature) that is the task of this book.*

The notion of a unitary science should not be understood (interpreted) that it must be reduced to a formula or a system of equations, but it should be understood that it must have an initial principle, since nature as a whole is a system structured by material elements (realities) in the form of material bodies, manifestations and processes which are interdependent because they are mutually linked with force (structural) connections, i.e. it is one material whole (material continuum). *Therefore, without matter there is no reality – there is no matter, or the notions of matter and nature are essentially synonymous.* **Because of this condition, we can contemplate a unity of sciences only in homogeneity (uniformity) of matters of diverse natural facts (realities).** *That is to say that the unity of science is predetermined only on condition that matter in nature (world), as a whole is homogeneous in essence, i.e. it is manifested in various parts which are object different in structure and organization, but with a homogeneous genetic essence, because they are formed from a single homogenous resource.*

Here, by diverse parts (objects) it should be understood such parts of non-living (mineral) and living (living organisms) matter, including human matter, *since living matter is a product of mineral matter.*

While searching a solution to the unitary essence of matter, i.e. to the material continuum of matter, which is synonymous with the notion of nature (Universe) a question arises, a common sense question – about the feasibility of such a solution, by means of scientific thinking and the MFL (Method of formal logic). *The answer is yes. I.e. MFL provides solutions in the sense of common sense that the solution is logically properly only then, when the starting point (the system of truths) called prerequisite, is experimentally confirmed – a reliable truth. And that the inferences are also confirmed experimentally.*

That is why Rene Descartes asserted that no scientific claims should be accepted without experimental confirmation or application in practice.

Another question also arises, as to whether such a quest for a deductive principle, which is the theoretical basis of the whole knowledge of science of nature as one whole, is really needed.

The answer to this question is positive as a consequence of citations a) and b) and of what laureate of Nobel prize Richard Feynman wrote:

a) „We do not have one structure from which all is deduced; we have several pieces that do not quite fit exactly yet." and "If we put all these principles together, WE DISCOVER THAT THERE ARE TOO MANY. THEY ARE INCONSISTENT WITH EACH OTHER"

b) „**across the variety of these detailed laws** THERE SWEEP GREAT GENERAL PRINCIPLES WHICH ALL THE LAWS SEEM TO FOLLOW."

These citations of the Novel Prize Laureate, not specifically but in a categorical way state that in present-day physics there are realy **ad hoc** hypotheses, gaps and flaws in the form of incorrect or experimentally not conformed or obsolete or not updated truths, which should be dropped off physics.

But R. Feynman spoke quite clearly and explicitly about the availability of some unknown (potential) initial and basic principles which underlie the foundations of our physical knowledge.

3.2.2. The model of unitary homogenous matter
3.2.2.1. Initial formulation

In this sense, the notion of mass is a model (abstracted notion) of the notion quantity of matter (body, object) with the same quantity of matter, but concentrated in one point (without any volume or shape) but with the respective real properties, such as inertness and gravitation.

The model of material objects, respectively of the diverse natural facts, are structurs with a relative independence relative to the unitary material continuum, since they are also structural elements of the nature (material continuum). And the structural elements of the structures of material objects are formed out of homogenous (but of unknown essence) initial resource.

The motivation of the inference (principle) of this claim (law) that matter is of homogenous essence, is:

a) The unknowness of the initial resource is due to the circumstance that it is inseparable from its property spatiality, i.e. it cannot exist as a reality, without manifesting itself as a spatial structure with a volume, different and greater than zero.

b) The initial resource is carrier of the inherent (attributive) properties of the specific material objects, and these properties are the same only in essence for all objects.

c) the diversity of the objects, respectively of their properties is determined by the diversity of their structures as well as by the varieties in the kind of their structural elements (the structural elements can be separate diverse structures), and also by their number and their spatial states. For example, the same number and kind of structural elements can be structured into objects of various properties only through altering the spatial distribution of the places of their structural elements. Such diverse objects are called isomers in chemistry.

That is, the structural diversity of systems, such as natural facts, although the essence of their structural elements is homogenous, determines the diversity of their properties.

HERE WE SHOULD EMPHASIZE THE EXPERIMENTAL FACT THAT EACH QUANTITATIVE ALTERATION OF THE INITIAL RESOURCE OF INDIVIDUAL NATURAL FACTS, REFLECTS ON THEIR STRUCTURAL STATE - A FACT, WHICH RESULTS INTO ALTERATION OF THEIR PROPERTIES.

In view of the fact that in some cases, within certain limits of change in the structures of objects, their properties are slightly modified, whereby the objects do not alter their essential core features, so there is the notion of measure introduced as a measure of alteration of the boundaries of the structural states, where it is assumed that objects retain their properties.

3.2.2.2. Inferences

First. All natural facts in the form of relatively independent material objects are product of respective quantities of a homogenous initial resource, which is characterized by its basic properties, as follows:

a) law of conservation of the quantity of the initial resource (respectively, matter) – also known under the name of inertness

b) structural and organizational states, as a result of which objects manifest in two forms, which are:

1) substantial, with relatively greater density of matter, in various structural states

2) field form, with relatively much smaller density of matter and in various structures, such as: electric, magnetic and gravitational fields.

Second. These properties of the initial resource remain inseparable (inalienable, they form one whole) in each object (natuaral fact) and are called inherent, or attributive.

Third. The diversity of structures in the different objects has the effect that the objects have other properties as well, which are a consequence of the type of their structure, and for them this law holds true: that these properties determined the type of the respective structure are generated at the moment of generating of their structure and disappears at the moment of disintegration of their structure. Therefore, these properties are determined by the structure, which is not eternal, but there are structures which are considered to be lasting (eternal), of the order of 10^{30} years. Such is the elementary particle proton. The atoms and the molecules, which are a substantial form of matter, are also long-lasting.

Fourth. The properties determined by the structure should depend on the complexity of structure. Thus it follows that the simplest in terms of their structures objects have the fewes structurally determined properties. This means that there may exist objects with extremely small number of structures and structurally determined properties.

Therefore, the existence of such objects, as electron e^- and positron e^+ should be assumed as the initial, the lowest structural level of unitary matter. These elementary particles should be assumed to be the models after which are formed all other, more complex structures of elementary particles and macro objects. In the line of this thought, assumed as a core formulation, is the thesis of the homogeneous essence of unitary matter, out of which was formed the material continuum of various objects, which are structural elements of the concept of the notion Nature (Universe). This statement, regarded as a scientific fact (principle), motivates the notion of interaction between objects - an expression of the alteration of the structural bonds (force bonds) between them and the formation of a homogenous whole, called nature.

Fifth. So that the above formulations be true, as a result of which the principle of a homogeneous whole, called nature, is formed, it is necessary to validate by means of experiments the facts-truths that:

a) all natural facts are formed from a single (homogeneous) initial source, from which their diverse structures are created.

b) some elementary particles, with respective structure, may under certain conditions become (restructure) in others which are of the same resource (uniform in essence with the initial ones), but with different structurally determined properties.

c) the elementary particles with the simple structure can be restructured into more complex in structure, such as atoms and molecules, which form makro objects, i.e. the system of nature.

d) material elementary particles can become (restructure) into a field, and vice versa. That is matter can be transformed from a substantial into a field form and vice versa.

e) motion in its simplest form, such as trabsfer of matter from one place to another is inherent to material objects, i.e. motion is inextricable (immanent) property of the initial resource, respectively, of all material structures.

4. CONCLUSION

Electrons e^- and e^+ positrons at rest are the initial model, out of which through interactions occur[*]:

a) All natural facts are connected in one whole system called nature;

b) The initial deductive principle, the theoretical foundations both of nature as one whole, i.e. of the unitary science of nature, and of the fundamental deductive principles of individual natural facts, respectively of the theoretical foundations of specific sciences, which are called here Principal.

The above conclusion is grounded on the following:

1. They are stable spatial substantial (fermions) of the smallest, relatively independent structures in the form of independent electrical charges, from the initial homogenous resource, which without the property spatiality (volume different from zero) cannot be an explicit (notable) object, and therefore, an explicit, real object.

2. The different polarity of the charges is explained by the reciprocity of the structures, which fact allows them during interaction to get restructured into diverse natural facts, both at micro and macro level by means of respective order and number of restructuring, such as:

2.1. Accelerated electrons and positrons generate protons and neutrons;

2.2. Protons, neutrons and electrons make up atoms;

2.3. Atoms make up molecules, and they – substances;

Fundamental motivation

Electrons and positrons during respective interactions form all elementary particles, respectively substantial and field forms of electromagnetic matter, i.e. all natural objects, phenomena and processes are products of interactions between the bipolar electric charges - electron and positron.

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[*] Academician Y. B. Zeldovnich in his book "Drama idey v poznanie prirody" (Drama of ideas in exploration of nature), 1988 (p. 61), wrote: ***"The electron is indesctuctible, that is why it retains its electric charge. All the variety of forms in the surrounding nature is a result of motion, bounding and restructuring of electrons."***

NEWTONIAN SCIENCE IS NOT A HISTORICAL RELIC, BUT A THEORETICAL BASIS OF PRESENT-TIME AND FUTURE SCIENCE OF NATURE

ISAAC NEWTON WAS A MECHANIC AND ELECTRODYNAMIC

CHAPTER ONE
THEORETICAL BASIS OF NEWTONIAN ELECTRODYNAMICS AND OF ALL DYNAMICS IN GENERAL

1. INTRODUCTION

IT IS KNOWN THAT A CRUCIAL PREREQUISITE FOR THE POWER OF KNOWLEDGE IS NOT THE BELIEF IN A REPUTEDLY INFALLIBLE AUTHORITY, BUT THE IRRESISTIBLE POWER OF EXPERIMENTAL FACTS THROUGH WHICH THE MOST RELIABLE AUTHORITY SPEAKS TO US, THE AUTHORITY OF NATURE.

There exists an unwritten methodological principle in science, which states that when new experimental facts become known, they should be reflected in the already existing theory of the respective scientific field. If they cannot be directly reconciled with the existing theories, a possibility to correct these theories should be sought or a new theory should be created in order to realize the unity of knowledge in that scientific field and in science in general.

Such is the nature of man that he describes the material reality, in which he comes into immediate sensuous contact, by breaking it into separate parts (fragments), keeps them in his memory (mind) in the form of *reflected images, and then he forms models. In essence, science is a system of fundamental models of nature as a whole, i.e. a system of models of its parts. The models are not mirror reflections of reality, but they are more or less an adequate reflection of the real natural facts, respectively of the development of reality.*

Moreover, the terms, used to describe the models, are also modeled, in the sense of being simplified (abstracted) in the form of point-like objects, which are carriers only of the most essential properties. For instance, instead of the notion 'matter', the notion 'mass' is used, the latter being point-like, without a volume or structure.

Human knowledge of complex objects always endeavors to reduce them to something more elementary and simpler, to some elementary essence, relevant to the given stage (level) of scientific development of the structure of matter.

The problem of the elementary, in the aspect of the initial elementary essence (substance, substratum, or initial resource) of the model of matter, is crucial from the viewpoint of the choice of an initial principle for a theoretical description of the substantial essence of matter, **which in this book is treated solely and only as and in the from of electromagnetic matter, whose incomplete theory (since it did not describe the laws of gravitational field) was given by Maxwell.**

But after classical mechanics assumes that matter in nature is unitary (homogenous), and, on the other hand, electrodynamics (including relativist dynamics) assumes that there is electromagnetic matter, there follows the conclusion that there is no place without electromagnetic matter, i.e. electromagnetic matter is the single unitary matter of nature (the world).

In these circumstances, the model of the elementary is essentially a model of electromagnetic matter whose direct and primary (at the lowest structural level) holders of its essence, should be assumed to be: a) in a substantial form, as elementary particles: the electron and positron, and b) in a field form: the photon.

These elementary particles, which are considered models of electromagnetic matter, are formed (structured) of unknown initial resource. It is unknown, because it cannot manifest itself as something real without being in the form of a spatial structure, and for the time being experiments suggest that the smallest material structures of electromagnetic matter are elementary particles electron and

positron. Essentially, they are the smallest independent bipolar electric charges. These charges are essentially reciprocal structures of the unknown initial resource. **But from a formal perspective, since they are the smallest substantial building blocks of the unitary matter, they may be treated as the initial resource of electromagnetic matter that can convert into a field form.**

Out of electrons (electron and positron), through interactions are structured all natural facts (objects, phenomena and processes). Therefore, all natural facts are interrelated and interdependent, i.e. nature, which is a system of natural facts, is one whole. But the study of these facts is necessary to define their models and thus to form the knowledge of them as a system of models, because science is a system of models of natural facts (objects, phenomena, processes).

But during the study, the interdependence is cut off (structural bonds are canceled) and separate parts are obtained according to the purpose of the study. It is not until the parts have been analyzed as separate units, that grounds to unite them into one whole are sought.

All natural events (objects, phenomena, processes, etc.) unconditionally result from (are consequence from) or are essentially a product of the process of interaction, i.e. result of motion of matter from one place to another. The interactions result from the movement of matters in different quantitative values from one place to another (from one object to another) at corresponding speeds and forces (exchange of matter) between objects and other objects. **And as a consequence of the interaction, the quantitative values of the matters of objects are altered, and this fact entails alteration of their structural states. Because of these changes in the quantities of materials and structures of objects changes occur in their properties and dynamic states.** Or in a global aspect, these processes explain the nature of their changes in a progressive or regressive development.

The global sense of the process of interaction, which is essentially, on the one hand, a process of motion of parts of matter or objects from one (certain) to another (certain) place in nature, or from one to another relatively independent objects, and on the other hand, it is restructuring of matter (objects). In physics, this is a dynamic process, which is the fundamental principle (process) for all natural phenomena (processes) and which determines the eternal (continuous) alteration of the states (the structural states) of matter.

The reasons for the above statements is that in nature (material continuum) there are no parts or places without the matter, at least in the form of gravitational fields and photon gas (electromagnetic fields) which do not generate interaction, i.e. there are no places without movement and restructuring of matters. *And the processes of movement and restructuring in the simplest forms are interpreted in the section dynamics of physics. This fact states that all natural processes that lead to modification of properties and states of matter result from a process of interactions, respectively, the dynamic processes that cause changes in the quantities and structures of physical objects and their properties .*

Therefore, in a global sense, all natural processes are dynamic processes, i.e. processes of motion and restructuring of matters under different conditions of micro and macro levels, and physics studies only their simplest forms, treated formally only as motion.

In this global aspect, all physics and the sciences chemistry and biology treat dynamic processes. But under different conditions of motion and restructuring of matter and that is why they are chemical and biological dynamics and **therefore physics is the leader of Sciences of nature.**

In this sense, the processes of perception and thinking in the mind (brain matter) of living organisms, including humans, are dynamic processes of transfer - movement of materials and restructuring at micro level. But because of the special conditions under which they take place, they are given various specific names.

I.E. TEHRE IS NO PHENOMENON (PROCESS) IN NATURE WHOSE MOTIVATION (CAUSE) IN ITS BASIS (ROOT) IS NOT A PROCESS OF DYNAMICS - MOTION OF MATTER WHICH IS THE EXPRESSION OF THE ESSENCE OF THE PROCESS OF INTERACTION - OF MOVEMENT AND RESTRUCTURING OF QUNTITIES OF MATTER.

The motivation for this assertion is the fact that without motion of matter, i.e. without dynamics, there will be no change in the properties of matter of objects – there is no interaction and no alteration of the properties of objects, i.e. nature will be forever frozen in a stationary state.

Thus the dynamic process reflects the nature of the process of interaction between objects, only possible on condition that matter is homogeneous in nature, as implicitly and unawarely it was treated by Isaac Newton, who laid the effective foundations of the Sciences of Nature. In support of this assertion comes also the fact that the notions quantity of matter, respectively mass, were described by the same properties in his books: "Mathematical Principles of Natural Philosophy" of 1687 and "Opticks ..." of 1704.

I.e. all natural phenomena (processes) are inherently processes of interaction between parts (objects) of a homogeneous electromagnetic matter whose simplest forms of action are treated in the section dynamics of physics.

Here the question of the unitary (homogeneous) in its essence nature is crucial because unitary matter is the initial and grounding (fundamental) factor to justify the viewpoint of a unitary nature (world) and of the unity of the science of natural phenomena, because science explores the manifestations of matter .

Moreover, the characteristic features of the conceptual picture of nature are:

1. Nature is a unitary whole - a material continuum, whose parts (objects) are genetically related in a coherent whole.

2. Matter is unitary and its essence is electromagnetic.

3. Matter is eternal, it can neither be created from nothing, nor can it turn into anything (disappear).

4. The details of are in perpetual motion (alteration) and restructuring.

5. All natural laws are interrelated because they have one deductive principle - one theoretical basis.

Or the summary of these features states:

Nature is a whole, comprehensive system that is a harmonious whole, in the form of a material continuum, which is functionally and genetically homogeneous self-evolving system. This conception is essentially interpreted as a principle of materiality - PM.

To substantiate the above features of the conceptual picture of nature, there are enough experimental facts in physics. ***But the nature of the contents of this physics, in essence, almost contradicts the above features, whose numbers are: 1, 2 and 5, although there are sufficient experimental proofs for their justification (grounding), two of which are, for example, in chronological order:***

First. ISAAC NEWTON, IN HIS BOOKS OF 1687 "MATHEMATICAL PRINCIPLES OF NATURAL PHILOSOPHY" AND THE 1704 "OPTICKS OR A TREATISE OF THE REFLECTIONS, REFRACTIONS, INFLECTIONS AND COLOURS OF LIGHT", FIRST GAVE THE CUMULATIVELY IDEA OF UNITY, CONTINUITY AND INTERNAL LOGIC OF KNOWLEDGE ABOUT NATURE AND NATURAL PHENOMENA AS ONE WHOLE.

But researchers and his followers studied initially only his book of 1687 "Principles ..." and did not relate his ideas from this book with his ideas from "Opticks ... "of 1704 that form one complete whole - Newtonian electrodynamics. This assertion is motivated by the fact that Newton in "Opticks ... " managed to prove experimentally in a most categorical way that the unitary matter in nature is solely and only of electromagnetic essence – it is electromagnetic matter, what is revealed by the synthesized quotes and the experimental facts from "Opticks ...", and which are described with modern terminology:

„All bodies emit and absorb electromagnetic waves."

"Bodies turn into electromagnetic waves and electromagnetic waves turn into bodies ..."

"These are normal natural laws."

Since electromagnetic waves are a field form of electromagnetic matter in the form of electric and magnetic fields, and they themselves generate gravitational fields, the great cumulatively idea that follows from this quote is obvious.

Second. *MOREOVER, THIS QUOTE, IN A PARAPHRASED FORM OF THE ABOVE QUOTES BY NEWTON WAS STATED IN 1860 BY THE LAW OF G. KIRCHHOFF: "THE RATIO OF THE EMITTED AND ABSORBED RADIANT ENERGY DOES NOT DEPEND ON THE KIND OF THE BODIES."*

IF RESEARCHERS OF NEWTON HAD TAKEN INTO CONSIDERATION NEWTON'S IDEAS IN HIS TWO BOOKS AS ONE WHOLE, THEN THEY COULD HAVE DEVELOPED DYNAMICS IN MODERN PHYSICS AS A UNIFIED SCIENCE OF MOTION OF OBJECTS IN THE SENSE OF MOTION OF ELECTROMAGNETIC MATTER WHICH ENCOMPASSES MAXWELL'S THEORIES, PART FROM THE SPECIAL THEORY OF RELATIVITY AND NEWTON'S GRAVITATION IN A WHOLE, ALL-COMPREHENSIVE THEORY - NEWTONIAN ELECTRODYNAMICS. SUCH AN ATTEMPT WILL BE MADE IN THIS BOOK.

2. SOME DEFINITIONS CONCERNING THE CLASSICAL PHYSICS OF NEWTON

2.1. Newton was the first who realized and showed in his theory that science does not create mirror images of reality, but its models, which reflect (are imprints), only of the most essential properties for a particular purpose of a study with abstracted (simplified) notions defined for the particular purpose. IN THIS ASPECT, THE SAME REALITY MAY HAVE SEVERAL MODELS DEPENDING ON THE PURPOSES OF THE STUDY

2.1.1. What is the meaning of the notion of mass
Newton introduced the notion of mass as a simplified mathematical model of the notion quantity of matter rather than as a property of matter.

Academician A. Polikarov wrote:

1. *„We should pay attention to the fact that as a general rule, the notion of mass is defined through the laws of dynamics, which in turn are formulated through the notion of mass."*

2. „It is known that Galileo had landed upon the idea of proportionality between force and acceleration, but was unable to formulate the law of momentum. Nor to define the notion of force, since the linking notion of "mass" was missing. The situation with the law of gravitation was similar. An idea was ripe that the force of attraction, is inversely proportional to the square of the distance (Borelin and Hook), but without the notion of mass the law could not be formulated."

3. *„The notion of mass turned out to be the key that could help solve the ripe problems of the time. That was exactly what Newton did by starting his "Principia" with the definition of the notion of mass."*

4. "The definition of the notion of mass presupposes that in its every specific form, matter has a quantitative aspect, which could be expressed, i.e. which could be measured. For this purpose, general properties of matter are used, such as: gravitation, inertia etc., which are proportional to the amount of substance and have additive character. We express them through the respective quantity of mass, which is used to measure them. Quantity of mass gives us the answer to the question „how much" (regardless of the form or kind)."

It is required that the location of the mass m in the volume of the body (of its quantity of matter Q), be so determined that a working model is obtained, which should describe the laws of its dynamics, i.e. the laws of its motion, whereby the acceleration $\vec{a}$, the velocity $\vec{v}$, the energy W and the trajectory of their motion depending on the time t, relative to a reference system K. This requirement could be met, if the location of the mass (the point in which the mass is concentrated) fulfills the following conditions:

a) The action of the total force upon the mass should have such a total result as it has during its action distributed upon the sum of all points of the volume of the body regardless of the form of its quantity of matter, whereby the total force is applied at the center of gravity of the body;

b) The distances between the bodies r with matters Q_1 and Q_2 should be equal to the distances between their masses m_1 and m_2 i.e. between the centers of their gravities.

c) The accelerations $\vec{a}$, the velocities $\vec{v}$ of the trajectories of motion of the bodies, as a result of the action of force $\vec{F}$, applied to the mass, should allow description in the space by means of Euclid's geometry in relation to the reference system K.

For the above requirements (conditions a, b and c) on the definition of the location of the mass, it should be taken into consideration that by Newton's time, there had existed the notion of force $\vec{F}$, but it was not defined and did not have a mathematical notation.

The written above, namely that the notion of mass is an abstract of the notion of quantity of matter (body) and the experimental fact that the same quantity of matter (body) has (generates) the properties of matter such as gravitational field and inertial force, an unequivocal (without alternative) inference follows that the same mass *m* generates both gravitational field $\vec{G}$ and inertial force $\vec{F}_i$, i.e.

$$\text{a) } \vec{G} = -\frac{m.\gamma.\vec{r}_0}{r^2} \quad \text{b) } \vec{F}_i = -m.\vec{a} \; ; \tag{1.2-1}$$

therefore, there is only one kind of mass, which generates $\vec{G}$ and $\vec{F}$.

The thesis of one kind of mass (*m*), in contrast to the thesis of two kinds of masses – gravitational (m_G) and inertial (m_1), explains the experiments of Yotvesh, Dike, and others.

*However, as it is known, when one fact can be explained equally well by several theories, of crucial importance when deciding which theory is **more reliable is the principle of simplicity.** In this meaning Einstein wrote in [4] (p. 266): „... **this theory is the most perfect that has the simplest formulations in its basis."** (emphasis added by P.P.).*

Therefore, the unyielding inference is that **there are not two kinds of mass, but only one kind, and it is not a property, but an abstract of the notion of quantity of matter**.

The obvious incorrectness of the claim that the notion of mass is a property of matter is even more conspicuous in its application in the law of gravitational force

$$\vec{F}_G = -\frac{m_1.m_2.\gamma}{c^2}.\vec{r}_0 ; \vec{r}_0 = \frac{\vec{r}}{|\vec{r}|}, \tag{1.2-2}$$

compared to Newton's thought in the citation, "...*that all bodies about the earth gravitate towards the earth, and that in proportion to the quantity of matter which they severally contain; that the moon likewise, according to the quantity of its matter, gravitates towards the earth.*";.

It is therefore necessary to rationalize physics with regard to the use of the notion of mass.

IN THIS SENSE, IN ORDER TO DESCRIBE THE LAWS OF PHYSICAL QUANTITIES IN THE LANGUAGE OF MATHEMATICS, WHICH DEALS WITH OBJECTS WHOSE GEOMETRYC IMAGE IS A MATHEMATICAL POINT, MODELS SHOULD BE CREATED OF PHYSICAL QUANTITIES IN THE FORM OF A POINT-LIKE NOTIONS WITHOUT VOLUME AND SHAPE, AND THUS THEY ARE REDUCED TO DIMENSIONLESS POINTS.

In present-day physics, although it is known that science explores the manifestations of what is called matter, in the form of natural facts, and matter is generator of these manifestations, the most commonly used notion is 'mass' instead of 'quantity of matter', or only matter. In the measurement system the quantity of matter is called amount of substance in chemistry and it has a unit of measurement called the mole (mol), the quantity of matter is the abstracted notion of mass and it has a unit of measurement called kilogram, which is also defined as the quantity of matter, by its weight.

Here are some citations from I. Newton's "The Principles …" of 1687 which prove that the abstracted notion which is both a physical and a mathematical model of the notion quantity of matter is the notion of mass:

1. On p. 23 he wrote, „The quantity of matter (mass)...; *"It is this quantity that I mean hereafter everywhere under the name of body or mass";*

2. On p. 503: "...that all bodies about the earth gravitate towards the earth, and that in proportion to the quantity of matter which they severally contain".

3. On p. 518: "... attraction exists between all bodies and is proportional to the mass of every body... and the attraction of planets one to another is inversely proportional to the square of the distance between the centers of the planets";

4. On p. 515: "Therefore the quantity of substance (mass) of gold relates to the quantity (of substance) of wood as the weight of the former to the weight of the latter. The same holds true for other bodies as well". More texts like the above citations can be found in [2].

5. There are other texts in the book as well, in the spirit of the above citations in the sense that the notion of mass is an abstracted notion of the notion of quantity of matter.

The interpretation of the above citations demonstrates with an irresistible evidential force of experimental facts that the notion of mass is an abstracted notion, it is a model of the notion of quantity of matter without volume or shape in the form of a dimensionless point, as a mathematical quantity whose geometric image is a point.

On the other hand, this definition was also questioned by Newton himself who wrote that there is gravitational and inert masses. He explores them by help of a pendulum and wrote that they differ in value with accuracy of 10^{-7}. Then they were examined by Yotvesh, Dike and others, who wrote that the masses are hardly different from each other, with accuracy of 10^{-12}.

TODAY WE BELIEVE THAT THERE IS ONLY ONE MASS WITH TWO PROPERTIES - GRAVITY AND INERTIA – WHAT WAS ALSO NEWTON'S FIRST IDEA, THAT THE MASS IS A MODEL OF THE QUANTITY OF MATTER. THIS MEANS THAT THE SAME QUANTITY OF MATTER (MASS) GENERATES SIMULTANEOUSLY THE PROPERTIES OF GRAVITY AND INERTIA, AS IT IS IN REALITY.

In conclusion, these are the definitions:

1. MASS IS NOT A PROPERTY OF MATTER, BUT ONLY ITS ABSTRACTED NOTION. IN THIS SENSE, THE NOTION OF MASS IS SYNONYMOUS WITH THE NOTION OF QUANTITY OF MATTER, BUT CONCENTRATED IN A POINT.

2. The expression of the correlation between the notions of matter and mass is: mass is matter without a volume and structure, m = Q

3. There is no inert and gravitational masses, but only one notion with inert and gravitational properties because there are no separate kinds of inert matter and of gravitational matter whose abstracted notions are respectively inert mass and gravitational mass.

4. Any form (field or substantial) of the quantity of matter, whose abstracted notion is mass, depends on its state of rest or motion.

Epilogue

THE NOTION OF MASS IS A BASIC THEORETICAL CONSTRUCT IN PHYSICS, *WHICH IS AN ABSTRACTED IMAGE AND IS SYNONYMOUS WITH THE NOTION OF QUANTITY OF MATTER, WITHOUT A VOLUME, WITHOUT A SHAPE, WITHOUT A COLOR, WITHOUT A TEMPERATURE, ETC. IN THE FORM OF A DIMENSIONLESS, BUT MATERIAL POINT, WHICH IS PLACED AT THE CENTER OF GRAVITY OF THE INTERPRETED OBJECT.*

The physical quantity of matter, which is initial and fundamental for the formation of nature while concurrently, it is a uniting link for all natural facts (objects, phenomena, processes, properties, etc.), through its abstracted notion of mass, participates directly or indirectly, through its properties, in mathematical formalizations and interpretations of all physical laws, since it is their generator and carrier.

TREATMENT OF THE NOTION OF MASS AS PROPERTY OF MATTER IS AN ESSENTIAL FLAW WITH REGARD TO NEWTON'S IDEAS, WHEN WE TAKE INTO ACCOUNT ITS REAL MEANING IN THE ABOVE CIITATIONS AND HIS ROLE IN PHYSICAL LAWS

Emphasis

THUS, BY INTRODUCING THE CONCEPT OF MASS (QUANTITY OF MATTER, WHICH IS CONCENTRATED INTO A POINT) IN THE CENTER OF GRAVITY OF THE OBJECT (BODY) THE START WAS GIVEN FOR THE DEVELOPMENT OF THE SCIENCE OF MOTION OF OBJECTS – DYNAMICS – MECHANICS.

2.2. What is the meaning of the notion of force

According to the system of measurements SI, the notion of force F has dimensionality

$$F \rightarrow [N] = [Newton] = [J \cdot m^{-1}] = \frac{Joule}{meter} = \frac{energy}{distance} = \frac{energy\ per\ unit}{distance\ (pathway)} \qquad (1.2\text{-}3)$$

i.e. the action of a force means that a body (mass) releases energy along a unit of distance (pathway) to another body, if the force is motive, or that energy is taken away along a unit of distance (pathway), if the force is arresting.

And bearing in mind the law of energy W and mass m.

$$a)\ W = m.c^2;\ b)\ m = \frac{W}{c^2}; \qquad (1.2\text{-}4)$$

it follows that force is carrier of energy, which is carrier of mass as well, and releases or takes away mass

$$m_F = \frac{W_F}{c^2}; \qquad (1.2\text{-}5)$$

Since Newton called the force "action" or "resistance", it is evident that formally there was no reason to consider the force as a factor (as it was not analyzed by its dimensionality), which fact changes the energy (mass) of the bodies upon which it acts, and namely, this circumstance accounts for the flawed interpretation of the first law of classical mechanics.

The definition of the notion of force is the second law of Newton in mechanics, and its interpretations is

Law II. *"The alteration of the quantity of motion is proportional to the applied motive force and takes place along the direction of this straight line, along which the force acts."*

$$\vec{F} = \frac{d\vec{P}}{dt} = \frac{d(m.\vec{v})}{dt}; \rightarrow [N] = [J.m^{-1}] = \frac{energy}{distance}; \qquad (1.2\text{-}6)$$

where: $\vec{v}$ – velocity of body of mass m.

The interpretation of this (the second) law in Newton's mechanics, according to academician S. Vavilov in his book "Isaac Newton", published by The Academy of Sciences of SSSR in 1961, Moscow, and translated into Bulgarian, *Tehnika* Publ. House, 1965, Sofia, Vavilov wrote on p. 142:

"The force in the second law can be determined through the alteration of the quantity of motion $\Delta(m.v)$, where Δ signifies the alteration, i.e. the mass m of the velocity v.

Mathematically, this law can be expressed in this way:

$$\Delta(m.v) = F.\Delta t; \qquad (1.2\text{-}7)$$

where: F is the force; Δt – the interval of time, when the alteration of the quantity of motion takes place. Or Newton's definition of the force is:

a) $\vec{F} = \dfrac{\Delta(m\vec{v})}{\Delta t} = \dfrac{d\vec{P}}{dt}$; b) $\vec{P} = m\vec{v}$; c) $m \neq \text{const.}$; (1.2-8)

i.e. in Newton's formula, the second law was not defined at m = const. And in this form $(m \neq \text{const.})$ **it is used in the theory of relativity.**

If we look at Newton's second law (1.2-8) as a definition of the mass through the force, we can make a general conclusion based on the experiment of P. I. Lebedev, who experimentally proved in 1900 that light exerts pressure upon the encountered bodies, i.e. it carries in itself a momentum. The size of this pressure, exerted upon a black plate of 1 cm² is $\dfrac{w}{c^2}$*, where w is density of energy of the light, which falls in one second, and c – velocity of light. According to Newton's second law (1.2-8), a momentum is understood as force of the light pressure, which corresponds to the alteration of the quantity of motion* $\Delta(m.v)$*.*

Light falling upon a black plate of mass *m* has initial velocity of light c. Being absorbed by the plate for time τ, the light "stops" – the final velocity of light is equal to zero. Therefore, according to Newton's second law

$$\Delta(m.v) = m.c - m.v = m.c - m.0 = \frac{w}{c};$$ (1.2-9)

whence the mass of light can be determined.

$$m = \frac{w}{c^2};$$ (1.2-10)

Thus, by applying Newton's law to the light, we have to ascribe mass to light." End of citation from Vavilov's book.

This citation of S. Vavilov's is about the light, which in the form of elementary particles, photons, which are a quantity of matter (electromagnetic matter) with electromagnetic energy in the form of momentums of electromagnetic waves moving at velocity *c*. That is why their velocity does not affect their mass. Because between the mass m_f of the photon and its energy W_f there is a relationship

a) $W_f = h.\nu = m_f.c^2$; b) $m_f = \dfrac{W_f}{c^2}$; (1.2-11)

In this line of thought, according to Newton's ideas in mechanics, the law of momentum holds true for the photon too

a) $\vec{P}_f = m_f.\vec{c} = \dfrac{W_f}{c}\vec{c}_0$; b) $W_f = \vec{P}_f.\vec{c} = m_f.c^2 = \dfrac{W_f}{c}\vec{c}_0$; c) $\vec{c}_0 = \dfrac{\vec{c}}{|\vec{c}|}$; d) $m_f = \dfrac{Q_f}{c^2}$; (1.2-12)

and, moreover, there is none of contradiction with the special theory of relativity (STR); on the contrary, STR uses the notions of momentum, mass and force defined by Newton.

Another reason for this conclusion is the fact that the quantity of *n* photons, to which energy $W_{f_n} = n.W_f$ corresponds, and which fall upon surface S, have momentum $\vec{P}_{f_n} = \dfrac{W_{f_n}}{c}$ and generate force

a) $\vec{F}_n = \dfrac{d\vec{P}_{f_n}}{dt} = \dfrac{d(W_{f_n}/c^2)}{dt}.\vec{c}_0 = \dfrac{dW_{f_n}}{c.dt}.\vec{c}_0 = \dfrac{dW_{f_n}}{dr}.\vec{c}_0$; b) $\vec{c}_0 = \dfrac{\vec{c}}{|\vec{c}|}$; (1.2-13)

I.e. by accounting for the fact that electromagnetic matter is in substantial and field form and that it can convert itself from one into another form and vice versa while retaining its quantity of matter (mass), it follows that the conclusions from the above citations and consequences from Newton's laws coincide with the laws of Maxwell's electrodynamics. In *Treatise on electricity and magnetism,* in paragraph 792, in 1873, he wrote: **"In a medium where electromagnetic waves propagate, pressure is generated in direction of the waves, which is numerically equal to the quantity of energy in a unit of volume."** The mathematical notation of this citation is

a) $w = \rho.c^2$; b) $\rho = \dfrac{w}{c^2}$; (1.2-14 a)

where: *w* – the density of energy in a unit of volume; ρ – the density of the electromagnetic mass.

If (1.2-14 a) is integrated for volume V, we have the formulae, which Einstein[*] gave as a novelty in 1905 because this regularity had not been clearly pointed out in publications by Maxwell's researchers.

$$\text{a) } W = m.c^2; \quad \text{b) } m = W/c^2; \tag{1.2-14 b}$$

There are two notes to the above definition of Maxwell's:

First note

In paragraph 636 of "Treatise…" Maxwell wrote: "We should consider both magnetic and electromagnetic energies as kinetic energies"

Second note

Paragraph 636 of "Treatise..." states: "..., that kinetic energy is available wherever there is a magnetic field. The quantity of the kinetic energy in a unit of volume of the field is

$$\frac{BH}{2} = \frac{\mu_0.H^2}{2} = w_H \text{ ".}$$

P. I. Lebedev in *Sobranie sochineniy* (Collected Works), Publ. by Academy of Sciences of the SSSR, 1963, on p. 379 wrote: "The analogy existing between light, sound and hydrodynamic oscillations is not confined only to the kinematic side of these phenomena, but goes much deeper and comprising also their dynamic properties. In 1902 Lord John Rayleigh proved theoretically that ***any waveform motion, which propagates at finite velocity, generates pressure upon any obstacle it encounters on its way of propagation*** ". **I.e. once a phenomenon is proved to be of wave character, then it follows that this phenomenon always generates a force of pressure - momentum.**

FROM MAXWELL'S LAW (1.2-14) AND THE SUMMARY MADE BY LORD RAYLEIGH IT FOLLOWS THAT WHEN DESCRIBING PHOTONS WE SHOULD ACCOUNT FOR THE FACT THAT THEY GENERATE PRESSURES - FORCE.

2.3. Isaac Newton was the first to give the law for conservation of energy

2.3.1. Introductory thoughts

In general, the beginning of modern science was laid by Isaac Newton in the seventeenth century by his publications, among which his books ***Mathematical Principles of Natural Philosophy*** of 1687 [Literature 1], ***Opticks or a treatise of the reflections, refractions, inflections and colours of light***" of 1704 [Literature 2] and a number of other works, including the creation of differential and integral calculus, i.e. **without Newton's works, modern science of nature and in particular of physics would hardly be possible.**

In his first book, ***Mathematical Principles of Natural Philosophy,*** translated into Russian by Academician Krylov, 1936, *the emphasis is on the laws for motion of discrete electromagnetically neutral objects (bodies) at velocities much lower than the velocity of light (electromagnetic waves, photons) c $(v \ll c)$ as well as on the law for the gravitational force. And by applying widely a mathematical analysis, he also laid the foundations of cosmology.*

*Since at the time of initial development of mechanics, the science of electricity was not of current concern, in [1] no special attention was paid to it, however, that was done by Newton's book **Opticks or a treatise of the reflections, refractions, inflections and colours of light** of 1704. That book contains essential laws, described as empirical laws, which are a remarkable contribution to the entire development of mechanics [the laws for the motion of matter (the bodies, which are discrete parts of the matter of nature)]. **Here, by experimental facts, it was essentially proved that the matter of nature is only of electromagnetic essence – it is electromagnetic matter.***

After Newton, until the nineteenth century, mechanics (the science for the motion of bodies), has developed mostly extensively and has been established by the laws of ***Mathematical Principles of Natural Philosophy*** and their mathematical interpretation of electromagnetically neutral solid bodies made by Lagrange, Euler and others for velocities v much slower than the velocity of light c $(v \ll c)$, **but has not been intensified by the relevant laws from [2] – "Opticks…".**

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[*] A. Einstein. "Zur Elektrodynamik der bevegter Körper" Ann. Phys. 1905, 17 (891 – 921).

2.3.2. Motivation

Newton, who in "Principles..." of 1687 and "Opticks..." of 1704 used the notions of his age, when the notion 'energy' did not exist, because it was first introduced by Thomas Young in 1807 according to Y. Gelfer, who in his book "Istoriya i metodologiya termodinamiki i statisticheskoy fiziki" (History and Methodology of Thermodynamics and Statistical Physics), Publ. by Visshaya Shkola, Moscow, 1981, on p. 132 and 133, wrote: "Thomas Young" (1807), in his lectures on natural philosophy, wrote: *"In almost all cases, the work required to produce motion is proportionate not to the moment, but to the energy of the performed work for the production of the motion. The notion of energy means the product of the mass or weight multiplied by the square of speed"... "The product of the mass of bodies and the square of speed is called energy."* On p. 133 Gelfer wrote: "With Young, the expression $\frac{m.v^2}{2}$ was introduced by G. Coriolis". Newton, in "Principles…" [1] gave the following formulations as definitions and laws, including some notes to them related to the law of energy conservation. The formulations relating to the laws of conservation are:

A. „Definition II in [1] (p. 24). "*The quantity of motion is the measure of the same, arising from the velocity and quantity of matter conjointly.*"

Nowadays the notion of quantity of motion is called momentum and is designated by

$$\vec{P} = m_0.\vec{v} \; ; \tag{1.2-15}$$

B. *Definition III* in [1] (p. 25). "The *vis insita*, or innate force of matter, is a power of resisting, by which every body, as much as in it lies (is not connected to another body – P. P.'s note), continues in its present state, whether it be of rest, or of moving uniformly forwards in a right line." "This force is always proportional to the body whose force it is and differs nothing from the inactivity of the mass, but in our manner of conceiving it. *A body, from the inert nature of matter, is not without difficulty put out of its state of rest or motion.* (emphasis added by P. P.). Upon which account, this *vis insita* may, by a most significant name, be called inertia (*vis inertiae*) or force of inactivity."

Newton describes the inertial force as a negative product of the mass m_0 and the acceleration $\vec{a}$, i.e. with an opposite (negative) sign of the motive force $\vec{F}_d = m_0.\vec{a}$

$$\text{a) } \vec{F}_i = -m_0.\frac{d\vec{v}}{dt} = -m_0.\vec{a} \text{ ; b) } \vec{a} = \frac{d\vec{v}}{dt} \; ; \tag{1.2-16}$$

C. „Definition IV in [1] (p. 26). *"An impressed force is an action exerted upon a body, in order to change its state, either of rest, or of uniform motion in a right line."... "This force consists in the action only, and remains no longer in the body when the action is over"*, the above definitions A, B and C are given in **Mathematical Principles of Natural Philosophy [1] 1687**

D. Newton's laws on mechanics, according to [1] (p. 39 – 41) are:

Law I. *Every body continues in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed upon it.*"

Or, paraphrased using modern terminology, **Law I** states: *Every body has the property to retain its energy state, i.e. for each one body the law of conservation of its energy W holds true, i.e.*

a) at $v = 0 \rightarrow W = 0 = const.$

b) at $v = const. \neq 0 \rightarrow W = const. \neq 0$ (1.2-17)

c) i.e. at v = 0 or v = const. $\neq$ 0 $\rightarrow$ W = const.;

In order to make a more complete and more precise interpretation of (conclusions to) the above four (A, B, C and D) formulations, it is necessary to take into account the mathematical solutions, which Newton could have given as consequences of these formulations, as well as to analyze the dimensionality of the quantities, which were used, as seen today, at the contemporary level of knowledge.

The first essential question arises in relation with **Law I** *is clarification of the questions "What does the notion "state" mean and what is its dimensionality?"*

The second essential question is, "What is the physical meaning and what is the dimensionality of the notions "impressed force" and "innate force" – respectively "inertial force".

Answers:

1. In the sense of Newton's mathematical descriptions and solutions, according to which "the impressed force" changes the states of rest or uniform motion in a right line, it can be implied that ***the notion of 'state' according to Newton, as a result of the above formulations, and with our present-day ideas, is reduced to the energy states of the kinetic energy levels*** W_K ***of bodies in their respective states of rest or uniform motion.***

The inference that energy states (levels) are implied is motivated by the fact that the dimensionality of the notion of force is "released" energy per unit of distance, which in the system SI is

$$a)\ F \to \frac{[J]}{[m]} = \left[J.m^{-1}\right] = \frac{\text{Joule}}{\text{distance}} = \frac{\text{energy}}{\text{distance}};\ b)\ F = \frac{W}{r}; \qquad (1.2\text{-}18)$$

I.e. when the force $F \to \left[J.m^{-1}\right]$ ***acts upon the body along the distance (path)*** $d\vec{r}$ ***, it imparts energy to it and the body starts moving at velocity*** $v \neq 0$ ***, whereby the energy is***

$$a)\ dW = \vec{F}.d\vec{r} \to \left[J.m^{-1}\right].[m] == \text{Joules (energy W)};\ \to b)\ W = \int dW; \qquad (1.2\text{-}19)$$

or the force is

$$\vec{F} = \frac{dW}{dr}.\vec{r}_0 = \frac{\vec{v}.d\vec{P}}{v.dt} = \frac{d\vec{P}}{dt}; \qquad (1.2\text{-}20)$$

I.e. we have the complete physical meaning of the notion of force, which is in full compliance with its dimensionality, and corresponds to its definition by Newton.

However, Newton applied the principle of simplicity, which is obvious in [1] (p. 96):

"Rule I. ***We are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances.***"

Therefore, in defining the force, only the derivative of momentum $\vec{P}$ of the body is used, which is

$$\vec{F} = \frac{d\vec{P}}{dt}; \qquad (1.2\text{-}21)$$

I.e. the force is a derivative of the momentum $\vec{P}$ *in relation to time, which notion (quantity) in physics is of a lower rank than the notion of energy.*

2. According to Newton the notion of inertia means that the body does not change the state of its kinetic energy, respectively the state of its quantity of motion, i.e. at velocities

$$a)\ \vec{v} = 0;\ \to b)\ \vec{P} = m_0.\vec{v} = 0;\ \to c)\ W_K = \frac{m_0 v^2}{2} = 0, \qquad (1.2\text{-}22)$$

and at uniform straight-line motion at velocity

$$a)\ \vec{v} = \text{const.};\ \to\ b)\ \vec{P} = m_0.\vec{v} = \text{const.};\ \to\ c)\ W_K = \frac{m_0 v^2}{2} = \text{const.}; \qquad (1.2\text{-}23)$$

And the meaning of the notion of "innate force" is inertial force

$$\vec{F}_i = -m_0.\vec{a} = -m_0.\frac{d\vec{v}}{dt}, \qquad (1.2\text{-}24)$$

which at both velocities $\left(v = 0\ \text{и}\ v \neq 0 = const.\right)$ is

$$\left.\begin{array}{l} a)\ \vec{v} = 0; \to b)\ \vec{F}_i = -m_0.\dfrac{d\vec{v}}{dt} = -m_0.0 = 0 \\[2mm] b)\ \vec{v} = \text{const}; \to b)\ \vec{F}_i = -m_0.\dfrac{d\vec{v}}{dt} = -m_0.0 = 0 \\[2mm] c)\ \vec{v} \neq \text{const}; \to b)\ \vec{F}_i = -m_0.\dfrac{d\vec{v}}{dt} = -m_0\vec{a} \neq 0 \end{array}\right\}; \qquad (1.2\text{-}25)$$

I.e. the innate force of bodies is that they always endeavor to maintain the state (quantity) of their kinetic energy, which means that when force $\vec{F}$ ***is applied upon them (kinetic energy is supplied to them from outside through the force) they must counteract to the change of the state of the quantity of the value of momentum*** $\vec{P}$ ***and their kinetic energy*** W_K ***, by inertial force*** $\vec{F}_i$ ***, equal in value to force*** $\vec{F}$ ***applied from outside but with an opposite sign, i.e.***

$$\text{a) } \vec{F}_i = -\vec{F} = -\frac{dW}{dr}; \text{ b) } \vec{F}_i + \vec{F} = 0 ; \tag{1.2-26}$$

I.e. since the meaning of the force is energy per unit of path (distance), it follows that the inertial force acts to conserve the energy of the bodies via counteraction to the force applied from outside, i.e. this fact means that the bodies have the innate property to conserve their energy and this property is called inertia – the inertia, which in modern terminology has the meaning and is called:

LAW OF ENERGY CONSERVATION – LEC

In this meaning Newton quite consciously, through "Law I" (the first law of mechanics) using the notion of his time, inertia, formulated LEC and strictly observed it in his works. The fact that Newton strictly observed LEC is irresistible proof that Newton introduced LEC. IN THIS MEANING NEWTON, THROUGH THE FIRST LAW OF MECHANICS, "LAW I", BY MEANS OF THE NOTION OF INERTIA, INTRODUCED BY NEWTON, WHICH IN MEANING IS CONSERVATION OF THE ENERGY OF THE BODY (THE OBJECT), FORMULATED LEC IN THE CLASSICAL MECHANICS.

The quantity of kinetic energy, according to Newton at $m_0 = const.$ is

$$W_K = \int_0^v \vec{F}.d\vec{r} = \frac{m_0 v^2}{2} ; \tag{1.2-27}$$

And the derivative of W_K in relation to the velocity v is equal to the momentum

$$\vec{P} = \frac{dW_k.\vec{v}_0}{dv} = m_0.\vec{v}; \vec{v}_0 = \frac{\vec{v}}{|\vec{v}|} ; \tag{1.2-28}$$

This fact $\vec{P} = \frac{dW_k}{dv}\vec{v}_0$ *means that for the quantity of motion (the momentum), there should also exist a law –*

the Law of conservation of the momentum, LCM, as well as a Law of conservation of the kinetic energy, LCKE, which is synonymous to the Law of energy conservation, LEC.

Conclusion

The formulations set forth in this paragraph imply that Isaac Newton considered the law of energy conservation – LEC, as the first law of mechanics with the meaning of LEC and it is expressed through the meaning of the notion (property) of inertia (inertness). That is, the notion of inertness means that the state of the kinetic energy of a body with mass m remains constant, and that this law is inherent to all bodies (objects) for in those time the notion of energy did not exist . And the external manifestation of LEC is "the inertial force" $\vec{F}_i$, by which the body responds, by means of its property LEC, in the process of action from an external (applied) force acting towards changing the energy of the body, **which phenomenon is validated by the fact that the dimensionality of the acting force** $\vec{F}$ **is the energy released per unit of distance (path) of its action, or the energy, which the external energy releases from an external object to a given object.**

$$\text{a) } dW = \vec{F}.d\vec{r} ; \text{ b) } W = \int \vec{F}.d\vec{r} = W_k ; \tag{1.2-29}$$

And the inertial force $\vec{F}_i$ counteracts with the energy

$$\text{a) } dW_i = \vec{F}_i.d\vec{r} = -\vec{F}.d\vec{r} ; \text{ b) } W_i = \int \vec{F}_i.d\vec{r} ; \tag{1.2-30}$$

This is the explanation as to why in all his works Isaac Newton most strictly observed LEC. THIS FACT HAS IRRESISTIBLE EVIDENTIAL FORCE IN THE MEANING THAT NEWTON BY THE NOTION OF INERTIA MEANT THE PRESENT-DAY NOTION OF LEC.

2.3.3. Law III. *"To every action there is always opposed an equal reaction: or, the mutual actions of two bodies upon each other are always equal, and directed to contrary parts, otherwise the interactions between two bodies are equal but opposite in direction."*

To this law there is a text in **Principles**, *which states, "Such actions always result in change not in velocities, but in the quantities of motion, as long as the bodies are not subjected to other forces."*

Here, in this context, when "action" is mentioned, force should be understood, as it is in the text "otherwise the interactions between two bodies are equal but opposite in direction". And also, **Definition IV** (p. 26 of **Principles**) states, **"The applied force is an action, exerted on the body so that the body**

should change its state of rest of or regular straight-line motion – the force is manifest only in action, and as soon as the action is discontinued, it does not remain in the body. The body after this continues to retain its new state only due to its inertia."

Definition III (p. 25) states: **"The vis insita, or innate force of matter, is a power of resisting, by which every body, as much as in it lies, continues in its present state, whether it be of rest, or of moving uniformly forwards in a right line. … This force could be called inertial force."**

In the sense set forth herein, the third law results from the first one. I.e. LEC implies as a consequence that when motive force F_d acts, there must always be a reaction with the inertial force F_i so that

$$\text{a) } \vec{F}_d + \vec{F}_i = 0; \text{ or b) } \vec{F}_i = -\vec{F}_d; \tag{1.2-31}$$

or this notations is an expression of the effort toward energy conservation, i.e. LEC is in force.

2.4. On the double role of the notions of space and time

2.4.1. Introductory thoughts

The notions of space and time should be regarded in the following aspects:

- space is an abstracted notion of the property expansion (volume) of unitary matter;

- time is a chronological coordinate for determining the sequence of the moment values of matter when describing its property mutability (development and degradation).

Each material object (process, phenomenon), is characterized by the notions of space and time in two aspects (roles):

a) as quantity of volume (expansion) of space and as quantity of duration (durability);

b) as coordinate parameters (properties) of the object, which directly are not carriers of its essential (substantial) properties, but are necessary when describing it through mathematics, for specific identification (localization) of its arrangement in place and in space and in a chronological order of the specific states in time, in relation to a reference system (reference frame, reference) randomly chosen beforehand. Due to this the quantitative values of the coordinate properties are multivariant, without this exerting influence upon the essence and the quantity of the real properties, which are described in the previous point a).

IT IS EXACTLY IN THIS MEANING THAT THE COORDINATE PROPERTIES SPACE AND TIME ARE NOT DIRECTLY DEPENDENT ON THE SUBSTANTIAL ESSENCE OF MATTER (OBJECTS) BUT OUTSIDE MATTER THEY ARE INCONCEIVABLE.

c) by means of respective mathematical operations, most often through the difference between the coordinate parameters or only through difference between the coordinates, the quantitative values of expansion and of durability are obtained.

For instance:

C.1. With spatial coordinates, in relation to a random reference *i,* for the beginning r_{i1} and end r_{i2} of the length of a rod, its real length is

$$\text{a) } r_{12} = r_{i1} - r_{i2} = inv.; \text{ b) } r_{i1} = var.; \text{ c) } r_{i2} = var.; \tag{1.2-32}$$

C.2. With coordinates of time, in relation to a random reference *j* for the beginning t_{j1} of the time of setting in motion and t_{j2} for the moment of stopping the motion of the object, the motion has taken the time

$$\text{a) } t_{12} = t_{j1} - t_{j2} = \text{inv.}; \text{ b) } t_{i1} = var.; \text{ c) } t_{i2} = var.; \tag{1.2-33}$$

C.3. *Here, the formulation that the coordinate notions of space and time, as numerical values are random holds true, as long as their reference (the starting reference point) is randomly chosen and therefore they are variables $\left(r_i = var.; t_j = var. \right)$, but the real intervals of space and time determined by them are invariable (i.e. independent of the choice of reference $r_{12} = \text{inv.}$ and the reference $t_{12} = \text{inv.}$).*

2.4.2. Interpretations

In the above meaning, the coordinate notions of space and time are idealizations, with regard to numerical values (dimensional notions), of the real expansion and durability, determined in relation to a randomly chosen convenient reference – a reference system – RS, for mathematical description of the manifestations of a given object and its manifestations.

In this meaning the coordinate notions are not carriers of any gram of matter in material or field forms, but are inconceivable without matter in nature.

The above definition is the reason to state that:

- space is homogenous and isotropic and does not interact with matter, but matter influences it only by its inherent property expansion – alteration of the coordinates of its state. All manifestations of matter take place in space.

AND WHEN AVAILABILITY OF MATTER IN THE FORM OF GRAVITATIONAL FIELD IS TAKEN INTO CONSIDERATION, SINCE THERE IS NO PLACE WITHOUT MATTER IN NATURE, RESPECTIVELY, GRAVITATIONAL AND ELECTROMAGNETIC FIELDS, IT (THE GRAVITATIONAL FIELD) INTERACTS WITH THE LIGHT RAYS AND DISTORTS THEIR TRAJECTORY, IT, HOWEVER, DOES NOT DISTORT SPACE, AS IT IS SOMETIMES INCORRECTLY STATED THAT SPACE IS BEING DISTORTED.

In this sense the notion of a homogenous and isotropic spatial continuum is motivated as a carrier of the notion of coordinate space – coordinates.

- Time arranges and makes sense in chronological aspect of the sequence of moment states of material phenomena, of which it is accepted that they are in static states, which are interpreted by the notion of a constant change or motion of objects, in the process of their development, as a result of the constant interaction between them.

When measuring the alterations of an object in time from one into another state, we count the cycles n of an object chosen as a measuring one, which has uniform cycles of alterations (emission) by a unit of interval of time T_0, which is the standard measurement of time.

In this way we have a homogenous and linear measuring of intervals of time through the standard measurement of time.

In this meaning, the physical notion of time interval from one into another state of the object is measured by coordinate time for *n* cycles.

$$t = n.T_0;$$
(1.2-34)

From the aspect that the development of matter is without a beginning and without an end, it follows that time as a parameter of matter and is also without a beginning and without an end, i.e. it is eternal as is matter.

2.5. Principle of relativity and Galileo's transformations

2.5.1. Basic formulations

The fact of unity of all natural phenomena (natural occurrences), as a result of the homogenous essence of matter in nature, which is a carrier and generator of all natural occurrences in the processes of their development (alteration) and as a result of the eternal interactions between them in space and time, entails the problem how to describe mathematically these processes and their regularities.

It should be taken into consideration that all manifestations of matter on the one hand are homogenous and interdependent, by means of their structural bonds (forces), which determine the unity in the system of nature. However, on the other hand, they (the manifestations) have relative independence, which is expressed in this:

a) they are of different quantities of matter;

b) they have different structures;

c) they are in different states of motion (at different velocities);

d) they are in different places in the space of the unitary nature;

e) they alter in the time by different regularities;

f) in relation to different observers, they have identical regularities of their essential parameters, but their description has different coordinates for space and time.

From these facts a question arises, by what rules (by what algorithm) can the mathematical description of the manifestations (of the interactions) be made in relation to an observer, who is in a given place and at a given time, so that it (the description) could reflect the reliable truth about the respective manifestation (object).

For this purpose the principle of relativity, PR, states:

"Phenomena do not depend on the state of the reference system (RS), in which the observer is, if the system moves at constant velocity, i.e. $\vec{v} = \text{const.}$**"** Such systems at $\vec{v} = \text{const.}$, in relation to which the manifestations of matter are described are called inertial reference systems: IRS. In this aspect all RS,

which move at constant velocity one toward another are physically equal and are called IRS. The mathematical descriptions of their physical regularities are externally different, but there are correlative relationships between them, which make it always possible to ascertain essential regularities of the physical phenomena described in them.

In this meaning, the notion of relativity is in the aspect of specific relationships of the features of the description of the manifestations (phenomena, objects) observed by observers in one IRS – K in relation to another IRS – K'. **I.e. the relativity is an expression on the one hand of this that there exists physical equality between the descriptions in the two IRS, and on the other hand that the descriptions in the two IRS are for the same observer.**

The first formulation (inference) of THE PRINCIPLE OF RELATIVITY – **PR** *is this of Galileo.* He established that an observer, who moves uniformly in a straight line in relation to a given natural phenomenon (process) cannot see any change in this phenomenon, if it is described in IRS (inertial reference system), which moves at constant (uniform) velocity, in relation to which the phenomenon is described.

PR as a scientific fact (law) was first described by Galileo in 1632 in his book "Dialogue Concerning the Two Chief World Systems: Copernican and Ptolemaic", where he stated that the existing phenomena upon the deck of a ship do not depend on whether the ship is at rest or in uniform motion, i.e. that phenomena seem the same to two observers, of whom one is at rest, and the other moves in a straight line and uniformly in relation to the phenomena on deck of the ship.

From this assertion, as a formulation of **PR** of Galileo two main questions arise:

1. How does the motion of the reference systems, RS, influence the description of the phenomena, given by **PR,** during the transition from one IRS – K to the other IRS – K', which moves at constant and straight-line velocity v .

2. Are the changed (observed) parameters (quantities) of the same physical phenomenon in the different IRS comparable and under what conditions?

The answers to these two questions are:

a) ***the descriptions of the phenomena (the natural manifestations) does not depend on whether they are observed or not, provided the state and the form of the observers do not influence the energy upon the phenomena and***

*b) for the descriptions of the phenomena, subject of **PR**, during a transition from one IRS – K to another IRS – K', their coordinates and their velocities are always different in values, but are comparable, since they correlate one toward the other depending on the values and the directions of the velocities between the respective IRS, if the movements of the latter are in a straight line and uniform for either IRS.*

In the theory of Galileo PR was accepted as an apparent fact – a physical truth, and the introduction of IRS – K was necessary as a point of support (fact) for the mathematical description of the physical phenomenon by means of PR through IRS of the observers – IRS – K', K", etc., which have straight-line and uniform velocities – $v_1 \rightarrow v', v''$ ***, etc.***

Since it is confirmed experimentally that PR of Galileo also holds true for electromagnetic phenomena, then quite reasonably PR should be updated according to the new facts, by accepting that it holds true for all physical phenomena ("mechanical" and "electromagnetic").

BY THIS SUMMARY (UPDATE) WE WOULD LIKE TO EMPHASIZE THE FACT THAT **PR** IS ALSO VALID FOR THE VELOCITY OF LIGHT C, SINCE LIGHT IS AN ELECTROMAGNETIC PHENOMENON AND THEREFORE NO OTHER TRANSFORMATIONS ARE NEEDED EXCEPT THOSE OF GALILEO, I.E. ACCORDING THE PRINCIPLE OF SIMPLICITY, LT ARE NOT NEEDED. HOWEVER, DOPPLER EFFECT SHOULD BE TAKEN INTO ACCOUNT AS WELL AS THE RELATIONSHIP BETWEEN MASS AND VELOCITY WHICH WERE ASCERTAINED WITHOUT LORENTZ TRANSFORMATIONS (KAUFMANN'S EXPERIMENT IN 1901)

2.5.2.Galileo's transformations – GT

PR *means that there is physical equality between all IRS in respect of the algorithm of description of all mechanical and electromagnetic phenomena, in relation to all IRS, whose algorithm and description, set forth in a general form, bear the name (are called) Galileo's transformations –* **GT**. But only by **PR**, as a fact, it is impossible to achieve the analytical relationship (connection) between the different physical manifestations in the world without determining the algorithm of the transformations from one IRS to another IRS, by which they will be described in the language of mathematics. The transformation of the notation of the physical laws is done by equations of the transition from one IRS – K into another IRS – K', which moves at a straight-line and

uniform velocity in relation to IRS – K, in which the observer is located. Since it has been proven that **PR** holds true for all physical phenomena (mechanical and electromagnetic), then the description of the transformations of the physical laws established in the respective IRS – K, will also be done through equations called **GT**, which hold true for all physical phenomena (mechanical and electromagnetic). In a general form, **GT** for the coordinates, the velocities, the accelerations and the time when transforming one IRS – K into another IRS – K', which moves in parallel to the axis x at velocity v, these formulae hold true:

$$\text{a) } r = x - v.t \text{ ; b) } t' = t \text{ ; c) } a = \frac{d^2 r}{dt^2} \text{ at d) } m' = m = m_0 = const. ; \tag{1.2-3}$$

If during the motion of K' in relation to K $x' \uparrow\uparrow x$ or $\vec{v} \uparrow\uparrow \vec{x}$ and $\vec{v} \uparrow\uparrow \vec{x}'$

$$\text{a) } x = x - v.t \text{ ; b) } y' = y \text{ ; c) } z' = z \text{ ; d) } t' = t ; \tag{1.2-4}$$

whereby for the description of the differences (segments) in the coordinates 2 and 1 in IRS – K and IRS – K' it holds true

$$\text{a) } r_2 - r_1 = r_2' - r_1' \text{ ; b) } x_2 - x_1 = x_2' - x_1' \text{ ; c) } y_2 - y_1 = y_2' - y_1' \text{ ; d) } z_2 - z_1 = z_2' - z_1' \tag{1.2-35}$$

where

$$\text{a) } r^2 = \left(x_2 - x_1\right)^2 + \left(y_2 - y_1\right)^2 + \left(z_2 - z_1\right)^2 \text{ ; b) } r'^2 = \left(x_2' - x_1'\right)^2 + \left(y_2' - y_1'\right)^2 + \left(z_2' - z_1'\right)^2 ; \tag{1.2-36}$$

and for the velocities and the accelerations from (1.2-3), since $v = $ const. the following relationships are obtained

$$\text{a) } v' = \frac{dr'}{dt} = v_1 + v_2 \text{ ; b) } v = \frac{dr}{dt} \text{ ; c) } a' = \frac{dv'}{dt} = \frac{dv}{dt} = a , \tag{1.2-37}$$

whereby for the differences between the velocities in points 1 and 2 i.e. K and K' this relationship holds true

$$v_2 - v_1 = \Delta v_{12} . \tag{1.2-38}$$

In forming GT, Euclid's geometry was used, which is considered to be the first and initial section of physics and which is experimentally validated. Apropos, Euclid's geometry has no experimental confirmation, either.

GT are the missing link at the beginning of the development of physics, so as to connect the different natural manifestations in one system, and thence to connect the laws (the manifestations) of physics in the different points of space as well, so that there is a reason for achieving a unity of physical knowledge.

These formulae of **GT** hold true for all physical phenomena, including the velocity of light, with the present-day concept that there is no luminiferous ether, taking into consideration Doppler effect – **DE,** discovered in 1842, described by **GT**, and experimentally confirmed for light in 1867. *Einstein also deduced it in the special theory of relativity in 1905 in* "Zur Elektrodynamik der bewegter Körper" Ann. Phys. 1905, 17, 891 – 921, in *paragraph 7*. For the velocity of light u_c in relation to an observer moving at velocity $\left|\pm v\right| < c$, as a result of Doppler effect, at length of the waves $\lambda' = \lambda_0 = const.$ and at angle between c and $v \to \varphi = 0$ this relationship holds true:

$$\text{a) } u_c = v'.\lambda' = v_0.\lambda_0.\frac{\left(c \pm v\right)}{c} = \frac{c\left(c + v\right)}{c} = c \pm v \neq const. \neq c; \text{ b) } v_0.\lambda_0 = c = const. \tag{1.2-39}$$

where the frequency v' and the length of the waves λ' with Einstein are

$$\text{a) } v' = \frac{v_0\left(c \pm v\right)}{c\left(1 - \frac{v^2}{c^2}\right)^{\frac{1}{2}}}; \text{ b) } \lambda' = \lambda_0 \left(1 - \frac{v^2}{c^2}\right)^{\frac{1}{2}}; \text{ c) } u_c = v'.\lambda' = \frac{\left(c \pm v\right)}{c}.\frac{\left(1 - \frac{v^2}{c^2}\right)^{\frac{1}{2}}}{\left(1 - \frac{v^2}{c^2}\right)^{\frac{1}{2}}} = c \pm v \neq const. \neq c; \tag{1.2-40}$$

It is obvious and clear that as a result of DE , according to Einstein [1], the velocity of light in relation to a moving observer can be

$$\text{a) } u_c = c + v \geq c \text{ ; b) } u_c = c - v \leq c ; \tag{1.2-41}$$

Therefore the velocity of light u_c *in relation to a moving observer can be higher or lower than its wave velocity, i.e.* **there exist superlight velocities and transmission of signals at superlight velocity.** *This is a physical fact well-known for a long time, and facilities, necessary for practice are designed and used based on this fact.* **DE is** *unconditionally a reliable fact, due to which such is also the law (1.2-39) or (1.2-40). This law, as well as the case with* **DE,** *is a completely identical consequence of* **GT** *at velocity* $\pm v$ *and two IRS – K and IRS – K', for it was deduced by means of description of the phenomenon through* **GT.**

After W. Kaufmann in 1901 experimentally proved that matter (mass) of the electron m_e is function of its mass m_{e0} at rest and its velocity v, i.e.

$$m_e = m_{e0}\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}} = m_{e0}\left(1 - \beta^2\right)^{-\frac{1}{2}}; \ \beta = \frac{v}{c}; \tag{1.2-42}$$

and this relationship was summarized by Einstein in [1] in 1905, in paragraph 4, item 11, and here, in this book, it is only deduced in the sense that this relationship holds true for masses (matter) of all objects (bodies), i.e. that the masses m *of all bodies at velocity* v *are function of their masses* m_0 *at rest and the velocity* v *, i.e.*

$$m = m_0\left(1 - \beta^2\right)^{-\frac{1}{2}}; \tag{1.2-43}$$

this regularity should be taken into consideration with **GT** as well. In addition the expression for kinetic energy is altered as well, which according to Newton is

$$W_{k0} = \frac{m_0 . v^2}{2}; \tag{1.2-44}$$

whereby after calculating at $v < c$, Einstein obtained it for an electron, in paragraph 10, in this form

$$a) \ W_k = W_0\left[\left(1 - \beta^2\right)^{-\frac{1}{2}} - 1\right] = m_0 . c^2\left[\left(1 - \beta^2\right)^{-\frac{1}{2}} - 1\right]; \ b) \ W_0 = m_0 . c^2; \tag{1.2-45}$$

Here it is essential to emphasize that with electromagnetic fields, GT must be applied only for the densities of energies and their masses, and not to be applied not for the fields, since the relationship (1.2-43) is for their masses.

For instance, the electric field of the electron at IRS-K' rest ($v = 0$) is

$$a) \ E_0 = \frac{q_e}{4 . \pi . \varepsilon_0 . r^2} = \frac{q_e . k_e}{r^2}; b) \ k_e = \left(4 . \pi . \varepsilon_0\right)^{-1}; \tag{1.2-46}$$

to which correspond densities of energy w_e and masses ρ_e

$$a) \ w_{e0} = \frac{\varepsilon_0 . E_0^2}{2}; \ b) \ \rho_{e0} = \frac{w_{e0}}{c^2}; \tag{1.2-47}$$

where: ε_0 is the dielectric constant.

When transforming w_{e0} and ρ_{e0} in IRS – K', which moves at velocity $v = $ const. the densities alter to

$$a) \ w_e = w_{e0} . \left(1 - \beta^2\right)^{-\frac{1}{2}}; \ b) \ \rho_e = \rho_{e0}\left(1 - \beta^2\right)^{-\frac{1}{2}}; \tag{1.2-48}$$

hence it follows

$$a) \ w_e = \frac{\varepsilon_0 . E_0^2}{2}\left(1 - \beta^2\right)^{-\frac{1}{2}} = \frac{\varepsilon_0 . E'^2}{2}; \ \rightarrow \ b) \ E' = E_0\left(1 - \beta^2\right)^{-\frac{1}{4}}; \text{ and}$$

$$a) \ \rho_e = \rho_{e0}\left(1 - \beta^2\right)^{-\frac{1}{2}} = \frac{\varepsilon_0 . E'^2}{2 . c^2}; \ \rightarrow \ b) \ E' = E_0\left(1 - \beta^2\right)^{-\frac{1}{4}}; \tag{1.2-49}$$

In this sense, in relativistic electrodynamics, fields should be transformed through masses or energies, and this should be done not by means of Lorentz transformations, but by means of GT.

Here Lorentz transformations – **LT**, are not used because they are incorrect.

The arguments about **LT** irrelevance are given in the supplement under number 6.

3. MATHEMATICAL NOTATION OF THE THEORETICAL FOUNDATIONS OF NEWTONIAN ELECTRODYNAMICS: THE PRINCIPAL

This presentation of physics under the name of rational or updated physics is essentially a historical summary of dynamics in line with the idea of Newton[*] about physics with a single initial principle, which is in line with the experimental laws established by him, and they, in a systemized form, as a system K, state:

"All bodies emit and absorb light."   I

"The changing of Bodies into Light, and Light into Bodies ..."   II   } K

"... is very conformable to the Course of Nature ..."   III

In modern terminology, these Newtonian laws for the system K state:

"All bodies emit and absorb electromagnetic matter in a field form."   I'

"The substantial form of electromagnetic matter convert into a field form,   II'
and the field form of electromagnetic matter converts into a substantial form."   } K'

"These conversions are ascertained through experiments, i.e. they are natural (empirical) laws."   III'

These assertions were presented by Newton in his book *"Opticks..."* in 1704 and they have to be considered an inseparable part of his ideas in his book *"Principles.."*[**] of 1687., where he set fourth the thesis that matter is unitary (homogenous), and here, in *"Opticks..."* he proved that unitary (homogenous) matter has electromagnetic essence – it is electromagnetic matter.

By unitary electromagnetic matter it is understood that matter is a structure formed from a homogenous initial resource of unknown essence. The initial resource remains unknown because it cannot manifest itself as spatial (volumetric) reality without being in the form of some real spatial structure. This initial resource is the carrier of the attributive properties of the object, and the diversity of structural states of objects are the carriers of its structural properties.

Attributive properties are:

1. Quantity of matter (mass), which is a carrier of the tandem T_{m-w} mass - energy.

2. Inert property - an outward expression of the law of matter (mass) and energy conservation - T_{m-w}, i.e. the law of matter and energy conservation, LMEC.

3. Interaction between components (objects) of matter (mass).

4. Restructuring of the parts (objects) of matter (mass).

5. Generation of electromagnetic quantities (features) such as: electric charges, fields, masses and energies.

6. Generation of gravitational (secondary electromagnetic) quantities (objects) such as: gravitational charges (masses), gravitational fields, gravitational masses and gravitational energies

On the structural properties

Structural properties are those properties of electromagnetic objects, which are formed by modifying the spatial and quantitative structure of objects. Whereby:

a) *a spatial structure means the spatial location of the structural elements of the object.* Even with the same number and types of structural elements depending on their spatial distribution, an object can have different properties. In chemistry, this phenomenon is called isomerism. For example when the same number of carbon C and hydrogen H in the molecule C_5H_{12}, depending on their spatial location there are three substances: pentane, methylbutan and dimethylpropan and in chemistry this phenomenon is called isomerism;

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[*] Is. Newton. Opticks or a treatise of the reflections, refractions, inflections and colours of light, in Russian, Gostehizdat, Moscow, 1954

[**] Is. Newton. Mathematical Principles of natural philosophy. transl. into Russian by A. N. Krylov. Publ. by Academy of Science of SSSR, vol. 7, 1936.

b) each quantitative modification of matter (mass) of the object results in alteration of the number of its structural elements, which also requires alteration of the structure of the object, and thus some of its properties or creation of new properties. ***Natural diversity is due to the structural diversity of structures of homogeneous electromagnetic elements.*** When a property is changed within certain limits, it is assumed that the main feature is retained, it is in atomic isotopes.

In this sense, the lowest structural state of the electromagnetic matter in the form of elementary material (fermion) particles are the electron e⁻ and positron e⁺. That is why they are assumed to be the model of electromagnetic matter and can be converted from substantial into a field form of electromagnetic matter, i.e. in the form of electric, magnetic and gravitational fields - in γ photons and vice versa, from photons (field form) into a substances form, for instance, gamma photons γ_Γ in collision against a nucleus of an atom can convert into electron e⁻ plus positron e⁺.

Electrons (electron e^- and positron e^+) are the smallest independent electric charges with values $q_e = \mp 1,6.10^{-19}$ C that generate electric, magnetic and gravitational fields.

$$\text{a) } \vec{E} = \frac{q_e.\vec{r_0}}{4.\pi.\varepsilon_0.r^2}; \text{ b) } \vec{H} = \varepsilon_0.\left[\vec{v}.\vec{E}\right]; \text{ c) } \vec{G} = -\frac{m_{e0}.\gamma}{r^2}.\vec{r_0}; \text{ d) } \vec{r_0} = \frac{\vec{r}}{|\vec{r}|}; \tag{1.3-1}$$

where: ε_0 is dielectric constant of vacuum; $\vec{v}$ – velocity of motion of the electron; γ – the gravitational constant.

$$\text{a) } m_{e0} = \frac{(\mp q_e)^2}{4.\pi.\varepsilon_0.r_{e0}.c^2} = (\mp q_e)^2.k_m; \text{ b) } k_m = \left(4.\pi.\varepsilon_0.r_{e0}.c^2\right)^{-1}; \text{ c) } (\mp q_e)^2 > 0; \tag{1.3-2}$$

is the mass of the electron $\left(e_0^-, e_0^+\right)$ at rest., where: r_{e0} is computational radius of the electron.

Electric $\vec{E}$ and magnetic $\vec{H}$ fields have density of energies w_E and w_H and of masses ρ_E and ρ_H, as follows

$$\text{a) } w_E = \frac{\varepsilon_0.E^2}{2}; \text{ b) } w_H = \frac{\mu_0.H^2}{2}; \text{ c) } \rho_E = \frac{w_E}{c^2}; \text{ d) } \rho_H = \frac{w_H}{c^2}; \tag{1.3-3}$$

To ρ_E and ρ_H correspond gravitational fields

$$\text{a) } \vec{G}_E = -\rho_E.\frac{\gamma}{r^2}.\vec{r_0}; \text{ b) } \vec{G}_H = -\frac{\rho_H.\gamma}{r^2}.\vec{r_0}; \tag{1.3-4}$$

where: μ_0 is the magnetic constant of vacuum.

It is evident that electron e^- and positron e^+ generate electromagnetic and gravitational fields, energies, masses of electromagnetic matter. I.e. they are sources and carriers of the manifestations (properties) of electromagnetic matter, thus they are assumed, here and below, as model of electromagnetic matter. And their fundamental laws form the unitary theoretical basis (the unitary deductive principle) of the theory of the manifestations (properties) of electromagnetic matter.

The reasons for this assumption are:

First. *Macro-objects are formed from elementary particles of matter.*

Second. *There is a well-known experimental fact that from the initial state of matter in the form of electron and positron, under appropriately selected conditions and the reactions of interaction, any of the pre-selected elementary particles can be obtained. I.e. by electromagnetic interactions between elementary particles, other elementary particles can be obtained.*

Third. The first and second reasons entail conclusions about the following laws:

a) All elementary particles, including protons and neutrons have homogenous electromagnetic essence – they are electromagnetic matter. This thesis was put forward by W. Heisenberg, and now this thesis is a routine fact.

b) All natural resources (objects, phenomena, processes, etc.) are only electromagnetic, incl. atoms and molecules, they are all structures of electromagnetic particles, i.e. they are structural objects of electromagnetic matter.

Under these conditions the theoretical foundations of the manifestations of electromagnetic matter are formed from the theoretical foundations of electromagnetic and gravitational phenomena, which they generate. i.e. the system of equations of electromagnetic theory of Maxwell (Maxwell's equations of 1873) and the gravitational theory of Newton, described by the equations of S. Poisson of 1813 formed the theoretical basis (logical foundation) of the manifestations (natural facts) of electromagnetic matter.

Because the resulting system of equations of Maxwell and Poisson is effective as initial principle of the theory of all natural facts, respectively for all specialized (specific) sciences, this system essentially plays the role of a leading major initial principle and has been named Principal.

From the equations of Maxwell and Poisson is formed

<div align="center">

THE PRINCIPAL

</div>

$$\left.\begin{array}{lll} \text{a) } rot\vec{E} = -\dfrac{\partial B}{\partial t}; & \text{b) } div\vec{E} = \dfrac{\rho_e}{\varepsilon_0}; & \text{c) } \vec{D} = \varepsilon_0.\vec{E} \quad \text{I} \\[2mm] \text{a) } rot\vec{H} = \dfrac{\partial \vec{D}}{\partial t} + j; & \text{b) } div\vec{B} = 0; & \text{c) } \vec{B} = \mu_0.\vec{H} \quad \text{II} \\[2mm] \text{a) } rot\vec{G} = 0; & \text{b) } div\vec{G} = -\rho_m.4.\pi.\gamma; & \text{III} \end{array}\right\} \qquad (1.3-5)$$

In this Principal, all quantities are genetically homogenous

where: $\vec{B}$ and $\vec{D}$ are magnetic and electric inductions: ρ_e – density of the electric charge; ρ_m – density of electromagnetic matter (mass); γ – gravitational constant; ε_0 and μ_0 dielectric and magnetic constants of mass; $\vec{j}$ – density of current (if there is any).

Consequences of the Principal

1. It describes the unity of regularities both in field and substantial forms of matter.

2. It proves the unity (homogeneity) of electromagnetic and gravitational fields, i.e. their genetic unity.

3. It shows that there is a genetic unity between field and substantial forms of matter, and they can be converted into each other.

4. ***When this system of differential equations is integrated under respective, unlimited in number, boundary conditions, for the respective situations, the regularities of the respective diverse natural facts (manifestations) are obtained.***

5. *It is apparent for these diverse manifestations that there is no natural phenomenon without concurrent participation of electromagnetic and gravitational fields, since every electromagnetic field has a mass, density of mass* ρ_m *, and it generates a gravitational field.*

6. ***For independent electromagnetic fields without electric charge (*** $\rho_e = 0$ ***), electromagnetic waves are obtained whose masses generate gravitational fields G, i.e. the densities of the masses*** ρ_{mE} ***and*** ρ_{mH} ***of the electric field E and of the magnetic field H of the waves generate gravitational fields.***

7. The Principal (1.3-5) motivates the fact that in nature (world), without any discontinuation in its space, there is electromagnetic matter in the form of:

a) gravitational field (electromagnetic field of second kind).

b) photon gas (electromagnetic wave).

I.e. the Principal(1.3-5) is a synthesized expression of the principles:

7.1. Principle of unitary electromagnetic matter in nature (world).

7.2. Principle that nature is a material continuum, i.e. that matter in nature is continuous or that in nature there is no place without matter.

7.3. The synthesis of principles 7.1. and 7.2 leads to the conclusion that: **The notions of electromagnetic continuum or material continuum are synonymous to the notion of nature (world).**

8. IT IS APPARENT FROM THEM THAT THERE IS NO NATURAL PHENOMENON (OBJECT) WITHOUT CONCURRENT PARTICIPATION OF ELECTROMAGNETIC AND GRAVITATIONAL FIELDS, SINCE EVERY ELECTROMAGNETIC FIELD HAS A MASS, DENSITY OF MASS ρ_m , AND IT GENERATES A GRAVITATIONAL FIELD.

Emphasis I

Here the fact should be emphasized that the differential equations practically have unlimited number of real solutions, which depend on the boundary conditions, determined by the unlimited number of situations, in which they are solved. This property of theirs enables them to describe the natural diversity, i.e. they satisfy the requirement of unlimited number of solutions for the natural diversity of objects, phenomena, processes , etc.

Emphasis II

In explicit form and partly in implicit form, this Principal indicates that all natural phenomena are manifested only in altering the quantities and structures of material objects through motion from one place to another and from one state into another. I.e., in other words, the natural diversity is a result of the incessant processes of interaction between parts of matter (natural facts, which have relative independence).

I.e. all natural facts (objects, phenomena, processes, etc.), changing in time are products as a result of:

a) motions of different quantities of the initial resource, in the diverse structure of homogenous matter;

b) motions of matter along different trajectories;

c) any kinds of setting into motion, which are all only different forms of electromagnetic forces generated by various structures of a homogenous initial resource.

OR DEFINED IN A MOST GENERAL FORM – WITHOUT MOTION OR WITHOUT INTERACTION OF RELATIVELY INDEPENDENT PARTS OF HOMOGENOUS MATTERS THERE ARE NOT ANY NATURAL PHENOPMENA, I.E. WITHOUT MOTION OF TH PARTS OF AMTTER THERE CANNOT BE INTERACTION BETWEEN NATURAL AFCTS – THERE IS NO DIVERSE NATURAL EVOLUTION OF MATTER WHATSOEVER.

Emphasis III

Since science studies manifestations (objects, phenomena, processes, etc.) of unitary electromagnetic matter, out of which nature is formed, it follows that science of nature is one (homogenous) whole and should be called Naturology. And this unitary science of nature takes its origin from the theoretical basis of the Principal. Or this thesis holds true: **Unitary electromagnetic matter entails unity of sciences.**

Emphasis IV

Basically, the fact that matter is homogenous in its essence means that it is impossible for natural manifestations to be interpreted by more than one deductive principle (Principal), respectively by more than one logic or one logical foundation, i.e. by more than one initial theoretical basis of its electromagnetic matter – one Principal.

Emphasis V

THIS INITIAL DEDUCTIVE PRINCIPLE IS THE EMBRYO, AS AN INITIAL PRINCIPLE, WHICH DIRECTLY OR INDIRECTLY, IS IN THE ROOT OF ALL SCIENCES, WHICH STUDY NATURAL OBJECTS. THE MOTIVATION OF THIS ASSERTION IS THE FACT THAT HUMANS AND HUMAN MIND ARE NATURAL PRODUCTS, WHERE MIND IS ALSO PRODUCT OF BRAIN ELECTROMAGNETIC MATTER WHICH CONSISTS OF ATOMS AND MOLECULES, WHICH INTERACT WITH THE QUANTITIES OF ELECTROMAGNETIC MATTER (ENERGY) BROUGHT IN FROM THE OUTSIDE BY MEANS OF THE ORGANS OF PERCEPTION. THE RESULT OF THIS MATERIAL INTERACTION IS THE ACT OF MOTION OF LIVING ORGANISMS OF THE FLORA, FAUNA AND THE HUMANKIND.

Emphasis VI

About the gravitational filed Einstein[*] wrote: "Now we will try to find out the laws of gravitational field. In doing this, the equation of Poisson in the theory of Newton will serve as a model

$$div\vec{G} = -\rho.4.\pi.\gamma; \qquad\qquad (1.3\text{-}6)$$

where: γ is gravitational constant.

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[*] A. Einstein. "The meaning of relativity" Princeton Unic. Press. Princeton. N. J. 1921.

The basis of this equation is the idea that the source of gravitational field is the density of matter ρ*. It should be so in the general theory of relativity as well"* (P.P.'s emphasis)

Therefore, the density of electromagnetic matter of electron ρ_e of the electromagnetic waves in (1.3-6) generates gravitational field. *In real fact, Newton in "Opticks..." described an experiment, where the sun rays deflected from massive bodies.*

Einstein[*] wrote: "However, we cannot claim that these parts of the general theory of relativity, which can not be considered complete, are the full and satisfactory foundations of physics. Because it seems that the external field consists of two **logically** unrelated parts: gravity and electromagnetism", and

"For now we must admit that physics has no common theoretical foundations, which can be regarded as its logical foundation."

Einstein[**] also wrote: "So as to finish building the foundations of the general theory of relativity, it is *necessary that electromagnetic field is also included in it, which, according to our conviction, is the material out of which we have to build the elementary structures of matter."*

As regards unification of gravitational and electromagnetic fields as two sides of one whole, Einstein[***] wrote:

"It is quite natural that unification of gravitational and electromagnetic fields into a common picture would be a huge step forward. That would be a praiseworthy corollary of the age of theoretical physics, which starts with Faraday and Maxwell..., and the entire physics would become a closed theory..."

Those observations of Einstein's show that the Principal is not in contradiction with the views of Einstein, but rather – it gives the decision he sought – a unified theory of electromagnetic and gravitational fields.

Accent VII

Einstein in the article "Prologue" in the book M. Plank. Where is science going? London. 1933, 9-14, wrote: *"With each significant movement of physics forward the fundamental laws get more and more simplified.*

Conclusion to the third paragraph

MATTER AND ITS MANIFESTATIONS AS WELL AS ALL FORCE INTERACTIONS AS CAUSATIVELY AND GENETICALLY UNIFORM PHENOMENA, HAVE ONLY ELECTROMAGNITEN NATURE, I.E. THE PRINCIPLE THAT UNITARY MATTER OF NATURE IS ELECTROMAGNETIC MATTER AND IS UNCONDITIONALLY AND CATEGORICALLY ADEQUATE FUNDAMENTAL PRINCIPLE OF PHYSICS.

4. NEWTONIAN ELECTRODYNAMICS

From the presented above, according to Newton, these regularities are known:

1. Electromagnetic matter exists in discrete quantities (parts) of matter (mass) m in the form of bodies and elementary particles.

2. Parts, including the elementary particles, of electromagnetic matter are ceaselessly converting from a substantial into a field form and vice versa, i.e. electromagnetic matter manifests in substantial and field forms.

3. The parts of electromagnetic matter in the form of electromagnetic waves (photons) are in constant motion at velocity of light c.

4. Matter (mass) m of electromagnetic waves, which move at the velocity of light c and have a momentum

$$\vec{P}_c = m.\vec{c} \tag{1.4-1}$$

5. When electromagnetic matter (mass) m of electromagnetic waves at velocity c and momentum $\vec{P}_c$ (1.4-1) collides (converts) for time dt into its substantial form (substance), electromagnetic force is generated

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[*] A. Einstein Considerations concerning the Fundaments of Theoretical Physics Science, 1940. 91, 481.7-492.

[**] A. Einstein. Considerations concerning the Fundaments of Theoretical Physics. Science. 1940, 91, 487 – 492.

[***] A. Einstein. Aether und Relativitäts theorie" Verlag von Julius Springer. Berlin, 1920.

$$F = \frac{d\vec{P}}{dt} = \frac{dm}{dt}.\vec{c} + \frac{d\vec{c}}{dt}.m = \frac{dm}{dt}.\vec{c} + 0;$$ (1.4-2)

6. The energy dW, which electromagnetic force F imparts onto the object, on which it acts along distance $d\vec{r} = c.dt$, i.e. for time dt is

a) $dW = \vec{F}.d\vec{r} = \frac{dm}{dt}.\vec{c}.\vec{c}.dt = dm.c^2$; b) $W = \int_0^m dW = m.c^2$; (1.4-3)

7. Since electromagnetic substance can convert into field and vice versa, it follows that the law (1.4-3)b

$$W = m.c^2;$$ (1.4-3)b

holds true both for the field and for the substantial forms of electromagnetic matter.

8. From (1.4-2) and (1.4-3) the inference follows that the substantial quantities of electromagnetic matter (masses) are always in states of variable values and can move at velocities v lower than c

a) $\vec{v} < \vec{c}$; b) $\beta = \frac{v}{c} < 1$; c) $m \neq$ const.; (1.4-4)

9. Under these conditions (1.4-3)b and (1.4-4), it follows that the expression of the momentum of substance is

a) $\vec{P} = m.\vec{v}$; b) $v < c$; c) $v \neq$ const.; d) $m \neq$ const. (1.4-5)

and the force is

$$\vec{F} = \frac{d\vec{P}}{dt} = \vec{v}.\frac{dm}{dt} + m.\frac{d\vec{v}}{dt};$$ (1.4-6)

10. Under condition (1.4-4)c, the relationship of the energy is

$$dW = \vec{F}.d\vec{r} = \frac{d\vec{P}}{dt}.\vec{v}.dt = \vec{v}.d\vec{P} = \frac{1}{2}m.d\left(v^2\right) + v^2.dm;$$ (1.4-7)

11. From dW (1.4-7) and W (1.4-3)b we have the value of the differential of mass (quantity of electromagnetic matter)

d) $dm = \frac{dW}{c^2} = \frac{1}{2}.m.d\left(\frac{v}{c}\right)^2 = \frac{1}{2}.m.d\left(1-\beta^2\right) + \beta^2.dm$; b) $\beta = \frac{v}{c}$; (1.4-8)

and after processing (1.4-8) we have the differential equation

$$\frac{dm}{m} = -\frac{1}{2}.\frac{d\left(1-\beta^2\right)}{\left(1-\beta^2\right)};$$ (1.4-9)

When this equation is solved for the following boundary conditions

a) $v = 0 \rightarrow m = m_0 =$ mass at rest; b) $v \neq 0 \rightarrow m = m > m_0$; (1.4-10)

we have the full mass m of a body with mass m_0 at rest as function of velocity, and with accounting for (1.4-3)b, we have the full energy W of the body at velocity v, i.e.

a) $m = m_0\left(1-\beta^2\right)^{-\frac{1}{2}}$; b) $W = m_0.c^2\left(1-\beta^2\right)^{-\frac{1}{2}} = W_0\left(1-\beta^2\right)^{-\frac{1}{2}}$; (1.4-11)

Where the term

$$W_0 = m_0.c^2;$$ (1.4-12)

is an expression of the internal energy of the part of electromagnetic matter at rest $(v = 0)$. I.e. this **formula (1.4-12) entails the inference that each quantity of electromagnetic matter m_0 at rest, according to (1.4-3)b, has internal energy, according to (1.4-12).**

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Therefore, after we subtract the internal energy $W_0 = m_0.c^2$ (1.4-12) from the full energy of the body with mass m_0 at rest W (1.4-11)b, the energy W_K remains, which was called by Newton in "Principles..." in 1687 kinetic energy, and by Maxwell in "Treatise..."magnetic or electromagnetic energy", and which has this value

$$W_K = W - W_0 = m_o.c^2\left[\left(1-\beta^2\right)^{-\frac{1}{2}} - 1\right] = W_H; \qquad (1.4-13)$$

and whose magnetic or electromagnetic (kinetic) mass essentially is

$$m_H = m_K = \frac{W_K}{c^2} = \frac{W_H}{c^2} = m_0\left[\left(1-\beta^2\right)^{-\frac{1}{2}} - 1\right]; \qquad (1.4-14)$$

Here it is important to emphasize that the formula given by Einstein for the relationship of the mass of bodies and velocity, in the Newtonian electrodynamics (1.4-13) and (1.4-14) is derived only from the experimental fact established by Newton in 1704 in "Opticks ... "that matter is only of electromagnetic essence, i.e. it is only electromagnetic matter and from Galileo's transformations, without the postulates of Einstein, or Lorentz transformations and without the special theory of relativity.

Magnetic (kinetic) energy W_K (1.4-13) and magnetic (kinetic) mass $m_H = m_K$ (1.4-14), here are obtained as values, which are product of electromagnetic matter, whose theory was developed by J. Cl. Maxwell in his book "Treatise on Electricity and Magnetism" in 1873, where he made it clear that in the theory of electromagnetic matter the role of kinetic energy is played by magnetic and electromagnetic energies. Whereby

a) in paragraph 636 he wrote: *"..., kinetic energy exists wherever there is a magnetic field, i.e. in all parts in general, where there is a magnetic field. Quantitatively, the density of magnetic (kinetic) energy is*

$$W_K = W_H = \frac{\mu_0.H^2}{2};" \qquad (1.4-15)$$

where: μ_0 is magnetic permeability of vacuum; H – magnetic field."

b) *in paragraph 638 Maxwell wrote:*

"**THEREFORE WE SHOULD CONSIDER BOTH MAGNETIC AND ELECTROMAGNETIC ENERGIES AS KINETIC ENERGIES.**"

This statement of Maxwell is confirmed by the inference from the formula of the kinetic energy of the electron by Einstein[*], with mass

$$a)\ m_e = m_{e0}\left(1-\beta^2\right)^{-\frac{1}{2}};\ b)\ \beta = \frac{v}{c}; \qquad (1.4-16)$$

where for mass m_{e0} he assumed that the mass of the electron at rest, i.e. at velocity $v = 0$; c – velocity of light.

In the inference (1.4-16), Einstein in paragraph 10 assumed the electron as a model of matter and that it is set into motion at velocity $v < c$ by the electrostatic force of an external electrostatic field $\vec{E}_B$, where the force is

$$\vec{F}_E = q_e.\vec{E}_B = \frac{dP}{dt} = \frac{d\left(m_e.\vec{v}\right)}{dt} = m_{e0}\left(1-\beta^2\right)^{-\frac{3}{2}}.\frac{d\vec{v}}{dt}; \qquad (1.4-17)$$

Thus the kinetic energy of the electron is obtained, which is essentially the magnetic energy of the electron at velocity v, *i.e.*

$$W_{Ke} = W_{He} = \int_0^v \vec{F}_E.d\vec{x} = m_{e0}.c^2\left[\left(1-\beta^2\right)^{-\frac{1}{2}} - 1\right]; \qquad (1.4-18)$$

where: q_e is the electric charge of the electron, which at rest $\left(v = 0\right)$ has mass m_{e0}.

About this expression of magnetic energy of the electron, Einstein[**], after the deduction of the formula of W_K, without mentioning that it is W_{He} wrote:

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[*] A. Einstein. "Zur Elektordynamik der bevegter Körper" Ann. Phys. 1905, 17, (891 – 821).
[**] A. Einstein. "Zur Elektordynamik der bevegter Körper" Ann. Phys. 1905, 17, (891 – 921).

"This expression of kinetic energy holds true for all bodies".

If Einstein had made an enquiry with Maxwell's treatise he could have written that the expression is about magnetic energy of bodies.

EMPHASIS

THEREFORE, BY THE TIME WHEN MAXWELL'S ELECTROMAGNETIC THEORY HAD BEN ESTABLISHD, RESEARCHERS FAILED TO NOTICE THAT MAGNETIC ENERGY, IN THE OPINION OF MAXWELL, AND ELECTROMAGNETIC ENERGIES ARE KINETIC ENERGIES.

THIS FAILURE SHOULD BE CORRECTED IN THE SENSE THAT AT PRESENT AND IN THE FUTURE, IT SHOULD BE ASSUMED THAT KINETIC ENERGY IS ONLY AND SOLELY MAGNETIC AND ELECTROMAGNETIC ENERGY.

In this comprehensive Newtonian mechanics, the momentum $\vec{P}$ (1.4-5) is

$$\vec{P} = m.\vec{v} = m_0.\left(1-\beta^2\right)^{-\frac{1}{2}}.\vec{v}; \tag{1.4-19}$$

Force F (1.4-6) is

$$\vec{F} = m_0\left(1-\beta^2\right)^{-\frac{1}{2}}.\frac{d\vec{v}}{dt} + m_0.\frac{v}{c^2}\left(1-\beta^2\right)^{-\frac{3}{2}}.\frac{\vec{v}.d\vec{v}}{dt}; \tag{1.4-20}$$

By taking into account that $\vec{v}.\vec{v}.\dfrac{dv}{dt} = v^2.\dfrac{d\vec{v}}{dt}$ and process (1.4-20) we have

$$\vec{F} = m_0\left(1-\beta^2\right)^{-\frac{3}{2}}.\frac{d\vec{v}}{dt}; \tag{1.4-21}$$

Inert force is

$$\vec{F}_i = -\vec{F} = -m_0\left(1-\beta^2\right)^{-\frac{3}{2}}.\frac{d\vec{v}}{dt}; \tag{1.4-22}$$

In general, there is no velocity, which is not a velocity v of motion of a body of mass $m > 0$, i.e. there are no independent velocities free of the component of the momentum of a real body with a real mass

$$\text{a) } \vec{P} = m.\vec{v}; \text{ b) } \vec{v} = \frac{\vec{P}}{m}; \tag{1.4-23}$$

So, essentially, it follows from (1.4-23) that there is not and there cannot be , from a strictly physical standpoint, any addition of independent velocities only, but there always should be addition of velocities determined by a respective momentum, as described in (1.4-24)b, i.e.

$$\vec{v}_{1,2} = \vec{v}_1 + \vec{v}_2 = \frac{\vec{P}_1}{m_1} + \frac{\vec{P}_2}{m_2} = \frac{\vec{v}_1.m_2 + \vec{v}_2.m_1}{m_1.m_2}; \tag{1.4-24}$$

Only when

$$\text{a) } m_1 = m_2 = m; \text{ b) } \vec{P}_1 = m.\vec{v}_1; \text{ c) } \vec{P}_2 = m.\vec{v}_2; \tag{1.4-25}$$

it follows that

$$\vec{v}_{1,2} = \vec{v}_1 + \vec{v}_2 = \frac{\vec{P}_1}{m} + \frac{\vec{P}_2}{m} = \vec{v}_1 + \vec{v}_2; \tag{1.4-26}$$

Then at mass $m = m_0\left(1-\beta^2\right)^{-\frac{1}{2}}$ the velocities can be added

$$v_{1,2} = \frac{v_1}{\left(1-\beta_1^2\right)^{\frac{1}{2}}} + \frac{v_2}{\left(1-\beta_2^2\right)^{\frac{1}{2}}} = \frac{v_1 + v_2}{1 + \dfrac{v_1.v_2}{c^2}}; \tag{1.4-27}$$

The presented above updated Newtonian mechanics could have been developed by Newton himself, since he was the creator of differential and integral calculus, or by a number of other scientists in the field of mechanics and electrodynamics before Einstein. However, there was no reason to doubt the classical mechanics of Newton, as was the issue with Michelson-Morley's experiment or the experiment of W. Kaufmann, who gave a negative answer to the expected results and thus challenged researchers two seek an explanation of that negative answer by putting forward numerous ideas, summarized by Einstein into a new theory called Special Theory of Relativity – STR, by introducing the principle of constancy of the velocity of light – PCVL, about which principle Einstein[*] wrote:

"..The fundamental Lorentz's principle that each light ray propagates in vacuum at constant velocity, called the principle of constancy of velocity of light", i.e. PCVL, was given by H. Lorentz, not by Einstein.

Here, of significant importance are some citations from Newton's "Opticks..." of 1704, which state:

1. "My design in this book is not to explain the properties of light by hypotheses, but to propose and prove them by reason and experiments."

2. *"As it is in mathematics, so it is in natural philosophy (the science of nature – P. P.'s note) that the method of analysis always precedes that of synthesis. Analysis consists in conducting experiments and observations, from which inferences are made by means of induction, whereby no other objections are admitted against those inferences but ones obtained in experiments or in other reliable ways, for hypotheses are tried by experimental science."*

3. *"The first obligation of science of nature is to draw conclusions from the phenomena, not to invent hypotheses, or to discuss the causes for actions, as long as the initial cause is found, the original cause, not the mechanical cause."*

4. "The Attractions of Gravity, Magnetism, and Electricity, reach to very sensible distances, and so have been observed by vulgar Eyes... perhaps electrical Attraction may reach to such small distances, even without being excited…"

5. *"it's well known that Bodies act one upon another by the Attractions of Gravity, Magnetism, and Electricity …"*

The citations given here and the formation of the theory of Newtonian electrodynamics as the initial principle of sciences of natural phenomena, support the thesis that the laws, which make up the electromagnetic essence of unitary matter are confirmed by sufficient experimental facts.

On the occasion of the 200th anniversary of Newton's death, Einstein writes: "In essence Newton fulfilled the dream of the ancient philosophers, materialist Democritus and Epicurus, who believed there was a causal relationship, without exception, in all physical phenomena."(emphasis added by P.P.)

"The science of electricity and magnetism up to this present day has developed entirely under the influence of Newton's guiding ideas... Even the revolution made by Faraday and Maxwell in electrodynamics and optics, which was the first, after Newton, remarkable radically new step in theoretical development of physics, was carried out under the influence of Newton's ideas."

"What we have achieved so far would have been impossible without the clear system of Newton".

The system of units SI proves that matter is electromagnetic

Proceeding from the brief definition of the essential aspect of the notion of science, which states that there is science of a certain object only when the properties of this object are treated by measuring them, i.e. WITHOUT MEASURING OF THE PROPERTIES OF THE OBJECT, THERE IS NO SCIENTIFIC TRUTH – THERE IS NO SCIENCE OF THAT OBJECT. I.e. THE SCIENTIFIC NOTION OF THE ESSENCE OF THE OBJECTS IS DEFINED AS A RESULT OF THE QUANTITIES OF THEIR MEASURED PROPERTIES IN REAL EXPERIMENTAL CONFIRMATIONS.

In this sense, the whole knowledge about the natural occurrences (objects, phenomena, processes, etc.) is impossible without a unitary system of measuring units for unified comparable measurements of the properties of the natural occurrences in appropriate experiments.

The most correct knowledge is gained only if it is set forth in the universally comprehensible language (terminology) of measurement, i.e. through a unitary (general) system of measuring units for all properties of all natural occurrences.

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[*] A. Einstein. "Relativitäts theorie" from the book Die Physik Unter Redaktion von Lechner. V. 3. Alt. 3. Bd. 1 Leipzig Teulner. 1915.

In the basis of forming the unitary measuring system lies the principle: independent measuring units are defined only for primary essences which are in the basis of the models of these essences, and for all other quantities, the measuring units are defined through mathematical correlations, which relate them to the primary essences (notions).

The choice of the system SI was not random, and was connected with the idea (principle) that nature is one whole system (structure) in the form of a unitary model, which is a system of homogenous in essence specific models (fragments), which describe (express) the diverse natural occurrences of homogenous essence, but with different structures. And it is exactly those different structures of the homogenous initial resource, existing in different quantities and structures that determine their different properties, which are objects of scientific studies – the different, specific (concrete) sciences or scientific fields.

This assumption is a result (consequence) of the fact of realizing that there exists connection of mutual dependence in the form of organic genetic connection between all natural occurrences (phenomena and processes). I.e. that they have as their carrier and generator a homogenous matter, called unitary matter, which was formed out of a unitary initial source.

In earlier times, it was believed that different natural phenomena were not organically connected with each other and therefore, their measuring systems were different. For instance, mechanics had its own measuring system. Electrical engineering had its own measuring system as well, different from the one of mechanics, because different terminology was used for the same quantities.

Then it was realized that a unitary measuring system had to be created which should be valid for all natural phenomena and processes by using only those measuring units which are in the basis of the primary essences of the main scientific models in the different scientific fields (theories). *For all other quantities measuring units were to be obtained through their respective mathematical correlations, which relate them to the primary essential measuring units.*

Here, in view of this analysis of the notion of mass (quantity of matter), it is crucial that the system SI agreed on a measuring unit of the quantity of matter, i.e. a quantity of the substantial form of matter, called mol.

This circumstance proves that the system SI admits that the notion of quantity of matter exists, whose measuring unit of quantity is the unit of mole.

The reason for this statement is the fact that the mole as a unit of quantity of substance, essentially means that the mole is a measuring unit of the substantial form of the quantity of matter, **i.e. the mole is a unit of the quantity of matter, which is most often used in chemistry, which matter is unconditionally only of homogenous essence, because it is the carrier and generator of all natural facts (phenomena and processes).**

And this matter, homogenous in its essence, called unitary matter, is unconditionally solely of electromagnetic essence, because it has already been admitted that such matter does exist, according to Maxwell's electromagnetic theory, and the fact that matter is unitary (homogenous) excludes any speculations of there existing any other form of matter.

Conclusion

The initial principle, which is in the basis of the measuring system SI (the international system of units), and which has irresistible evidential force with a rank of an experimental fact, is that electromagnetic matter, unitary and homogenous in its essence, occurring in a field and a substantial form, and being the generator of all natural occurrences (phenomena, processes, etc.) as an experimental fact of irresistible evidential force, since in SI, there are basic measuring units for the properties of electromagnetic matter .

The formulae of motion of bodies derived here result from Newton's citations in "Principles…" of 1687 and in "Opticks ..." of 1704 and hold true for all velocities v lower than c $(v < c)$ **,** *but the historical development of Newtonian electrodynamics (mechanics) first gave the classical mechanics of Newton, which treats motions of electromagnetic bodies at velocities v much lower than the velocity of light, i.e. at*

$$\text{a) } v \ll c; \text{ b) } \beta = \frac{v}{c} \rightarrow 0; \tag{1.4-28}$$

and in which classical physics takes into account only that matter is homogenous, while it dos not take into account the fact that there is matter, which has electromagnetic essence, of which later Maxwell developed a theory called electromagnetic theory of Maxwell.

Moreover, there exists a theory of electromagnetic matter at high velocities a) $v < c$; b) $\beta = \dfrac{v}{c} < 1$;

(1.4-4), called relativist electrodynamics (relativist mechanics), from which on condition that velocities are low, under condition a) $v \ll c$; b) $\beta = \dfrac{v}{c} \to 0$; (1.4-28) is reduced to the classical mechanics of Newton. The circumstance that it is reduced from relativist electrodynamics implies that it is also electrodynamics – a theory of electromagnetic matter at low velocities, which is now implicitly treated as a theory of unknown, but unitary (homogenous) matter.

THE RESULTING GENERAL NEWTONIAN ELECTRODYNAMICS (MECHANICS) AS A THEORY OF ELECTROMAGNETIC MATTER, UNCONDITIONALLY LEADS TO THE CONCLUSION THAT THE CLASSICAL NEWTONIAN MECHANICS IS ALSO A CLASSICAL ELECTRODYNAMICS, FOR IT DEALS WITH A UNITARY MATTER, WHICH IS ONLY ELECTROMAGNETIC MATTER AND OF WHICH THERE IS ONE UNITARY ELECTROMAGNETIC THEORY, AND IT IS THE GENERAL NEWTONIAN ELECTRODYNAMICS (MECHANICS).

Under condition (1.4-28) the expression $\left(1-\beta^2\right)^{-\frac{1}{2}}$ can be expanded in a power series

$$\left(1-\beta^2\right)^{-\frac{1}{2}} = 1 + \frac{1}{2}\beta^2 - \frac{3}{8}\beta^4 + \frac{15}{18}\beta^6 ...; \tag{1.4-29}$$

And by taking into consideration only the first two terms from (1.4-29), we have the energies, masses, momentums and forces with smaller values than in the general Newtonian electrodynamics, which are a specific case of it and coincide with classical mechanics, which should here be called classical electrodynamics. The motivation of the name classical electrodynamics is in the circumstance that the formulae of the General Newtonian electrodynamics hold also true under condition $\left(v \ll c\right)$ (1.4-28), but they are simplified with respect to the case at $v < c$ (1.4-4), without introducing the condition that matter is not electromagnetic. Therefore, **under the condition $\left(v \ll c\right)$ (1.4-28) the formulae of the General Newtonian electrodynamics (relativist electrodynamics) are reduced to:**

A) for the kinetic (magnetic) energy and mass

$$\text{a) } W_K = W_H = m_0.c^2\left[1+\frac{1}{2}\beta^2 - 1\right] = \frac{m_0.v^2}{2}; \text{ b) } m_H = m_K = \frac{m_0.v^2}{2.c^2} \ll m_0; \tag{1.4-30}$$

B) for the momentum and the force

$$\text{a) } \vec{P} = \frac{d\left(W_H\right)}{dv}.\vec{v}_0 = m_0.\vec{v}; \text{ b) } \vec{F} = \frac{d\vec{P}}{dt} = m.\frac{d\vec{v}}{dt}; \vec{v}_0 = \frac{\vec{v}}{|\vec{v}|}; \tag{1.4-31}$$

C) Whereby at $v \ll c$ (1.4-28), the expressions of the values of the magnetic (kinetic) energy (1.4-13) and (1.4-30), are almost equal, i.e.

$$W_K = W_H = m_0.c^2\left[\left(1-\beta^2\right)^{-\frac{1}{2}} - 1\right] \approx \frac{m_0.v^2}{2}; \tag{1.4-32}$$

D) The addition of the velocity (instead of (1.4-27), because $\dfrac{v_1.v_2}{c^2} \to 0$)

$$v_{1,2} = v_1 + v_2 \tag{1.4-33}$$

Since the essence of matter remains electromagnetic. I.e. in the General Newtonian electrodynamics matter remains unitary electromagnetic matter both at velocities $\left(v < c\right)$ (1.4-4) and at $\left(v \ll c\right)$ (1.4-28), and the deduction of the formulae is made without the theory of relativity and without Lorentz transformations, but only with Galileo's principle of relativity, Galileo's transformations and the assumption of the thesis of Newton that matter is electromagnetic in a field and substantial forms and can convert from a substantial into a field form and vice versa (according to Newton's citations in paragraph 3).

Therefore, electromagnetic matter, according to Newton, generates gravitational forces (fields). and indeed, in "Opticks .." in 1704, Newton described experiments, in which sun rays deflected by solid bodies as a result of gravitational forces.

Furthermore, there are well-known calculations in literature of the ratios of the electric forces $\vec{F}_E$ between electrons and gravitational forces $\vec{F}_G$ between the same electrons, which is

$$\frac{F_E}{F_G} \approx 10^{42};$$

(1.4-34)

which fact proves that in present-day physics it is assumed that electrons generates gravitational forces (fields).

The presented above entails the following conclusions:

General conclusion

*1. NEWTON FIRST PROVED EXPERIMENTALLY IN **1704** THAT MATTER HAS UNITARY HOMOGENOUS ESSENCE AND IS ONLY OF ELECTROMAGNETIC ESSENCE, I.E. IT IS ONLY ELECTROMAGNETIC MATTER, BUT UP TO THIS DAY THIS FACT HAS NOT BEEN TAKEN INTO ACCOUNT IN MODERN PHYSICS, THEREFORE THERE IS A TASK FOR PHYSICISTS TO CONSIDER THIS FACT BY DEVELOPING THE DETAILS OF PHYSICS AS LAWS OF ELECTROMAGNETIC MATTER.*

2. OTHER PROOFS, WHICH ARE LONG KNOWN TO RESEARCHERS OF PHYSICS, BUT HAVE NOT BEEN MADE EXPLICIT, THAT MATTER IS ONLY ELECTROMAGNETIC, ARE:

2.1. THE ASSUMPTION THAT IN MAXWELL'S ELECTRODYNAMICS, THERE IS ELECTROMAGNETIC MATTER, WHICH THEORY IS MAXWELL'S ELECTROMAGNETIC THEORY. THE FACT THAT IT IS PROVEN THAT MATTER IS HOMOGENOUS NECESSITATES THE INFRENCE THAT THERE CANNOT BE ANY OTHER KIND OF MATTER EXCEPT ELECTROMAGNETIC MATTER.

2.2. THE ASSUMPTION IN W. HEISENBERG'S THESIS THAT ALL ELEMENTARY PARTICLES ARE HOMOGENOUS IN ESSENCE, WHICH IS GROUNDED IN THE EXPERIMENTAL FACT THAT ELEMENTARY PARTICLES CAN BE CONVERTED FROM ONE INTO ANOTHER, WITH OBSERVANCE OF THE LAW OF CONSERVATION OF ENERGY.

*THIS ASUMTION THAT ELEMENTARY PARTICLES ARE OF HOMOGENOUS ESSENCE IMPLIES **THAT THE** ELEMENTARY PARTICLES, SUCH AS ELECTRON, POSITRON, PHOTON, PROTON, NEUTRON, ETC. HAVE A HOMOGENOUS ESSENCE, AS IS THE ESSENCE OF THE ELECTRON, POSITRON AND PHOTON. HOWEVER THE ESSENCE OF THE ELECTRON, POSITRON AND PHOTON IS ELECTROMAGNETIC, I.E. THEY ARE ELECTROMAGNETIC MATTER. WHENCE, DUE TO THE FACT (ASSUMPTION) THAT ALL ELEMENTARY PARTICLES, INCLUDING THE PROTON AND NEUTRON ARE ALSO WITH ELECTROMAGNETIC ESSENCE – THEY ARE ELECTROMAGNETIC MATTER. AND IN REAL FACT, THE EXPERIMENT (SEE NEXT PARAGRAPH) CONFIRMS THIS INFERENCE.*

SINCE ATOMS (MOLECULES) ARE STRUCTURES OF ELECTRONS, PROTONS AND NEUTRONS, THE IT FOLLOWS THAT ATOMS (MOLECULES) ARE ELECTROMAGNETIC MATTER. OR THE MOST GENERAL CONCLUSION STATES:

*ALL NATURAL FACTS (OBJECTS, PHENOMENA, PROCESSES, PROPERTIES, ETC) ARE OF ELECTROMAGNETIC ESSENCE, FOR **THEY ARE** PRODUCTS (PHENOMENA) OF ELECTROMAGNETIC MATTER.*

*3. ELECTROMAGNETIC MATTER IN SUBSTANTIAL AND FIELD FORMS GENERATES **GRAVITATIONAL FIELDS. I.E. GRAVITATIONAL FIELDS** ARE SECONDARY ELECTROMAGNETIC FIELDS. OR ALL FIELDS, WHICH ARE GENERATED BY THE UNITARY ELECTROMAGNETIC MATTER OF NATURE GENERATES, GENERATE ONLY ELECTROMAGNETIC ENERGIES, FIELDS AND FORCES.*

4. From the fact that all natural facts (according to Newton and Kirchhoff) emit electromagnetic waves in the form of photons, makes it evident that there is a photon ensemble in space, called photon gas. I.e. that in any point in space there are photons (density of photon gas), to which corresponds density of mass of a field form of electromagnetic matter ρ_f and density of electromagnetic energy $w_f = \rho_f . c^2$.

5. It should be taken into account that every photon is characterized by energy W_f, mass m_f and momentum $\vec{P}_f$

$$\text{a) } W_f = h.\nu; \text{ b) } m_f = \frac{W_f}{c^2}; \text{ c) } \vec{P}_f = m_f.\vec{c} = \frac{W_f}{c}.\vec{c}_0; \text{ d) } \vec{c}_0 = \frac{\vec{c}}{|\vec{c}|}$$

(1.4-35)

If inside the photon gas there is a gas molecule of mass m_M, upon which photons land, then each photon will act for time τ, so it will act upon the molecule with an average value of force

$$\vec{F}_f = \frac{\vec{P}_f}{\tau};$$
(1.4-36)

As a result of the density of the photons, which are in different directions, eventually the average value of the acting force $\vec{F}_{f\,cp.}$ at a respective density of photons, which is approximately proportional to ρ_f, i.e.

$$\left| F_{f\,cp.} \right| \equiv \rho_f = \frac{w_f}{c^2};$$
(1.4-37)

and sets the molecule in motion at acceleration $\vec{a}$ and velocity $d\vec{v}$ for time dt

a) $\vec{a} = \dfrac{\vec{F}_{f.cp.}}{m_M};$ b) $d\vec{v} = \vec{a}.dt;$ c) $\vec{v} = \vec{a}.t;$
(1.4-38)

I.e. the molecules, which are inside the photon gas, are set in motion by it at velocity $\vec{v}$, and therefore, since there is no place in space without a photon gas, the molecules are always in motion. It should be added that all the atoms (molecules) periodically emit and absorb photons, i.e. other photons act upon them forcefully, and therefore independent molecules are also always in motion.

And since in the space around the Earth there is always a gravitational field, it follows that photons with masses m_f and molecules with masses m_M are moved by gravitational forces toward the center of the Earth with the forces

a) $\vec{F}_{Gf} = m_f.\vec{G}_3;$ b) $\vec{F}_{Gm} = m_M.\vec{G}_3;$
(1.4-39)

where: G_3 is the gravitational field of the Earth.

5. RESTRUCTURING OF ELECTRONS AND ELECTROMAGNETIC ENERGY

5.1. General formulations

Electrons are used to illustrate restructuring, for they are generally used as a model of electromagnetic matter, and Einstein also did so in his article "Zur Elektrodynamik der bewegter Körper", 17, 891, 921.

The process of interaction between objects is accompanied by a process of their being restructured. As a result of these processes, the objects obtain new properties or lose previous properties and acquire properties different from these before the interaction.

To make a full and precise analysis and give an answer to the question of what energy is, it should be proceeded from the formulae through a mathematical description of some typical processes of interaction, which also have been experimentally confirmed for restructuring of matter of given objects from one state into another (from some elementary particles into others).

First example

During interaction between electron e_0^- and positron e_0^+ at rest ($v = 0$) they become restructured into photons (momentums of electromagnetic waves) γ, which move at the velocity c of light (of electromagnetic waves), equation (1.5.1-1)a.

And when a gamma photon γ_Γ collides into the atom nucleus, the photon is restructured into electron e_0^- and positron e_0^+, as follows

a) $e_0^- + e_0^+ \rightarrow 2.\gamma$; b) $\gamma_\Gamma \rightarrow e_0^- + e_0^+$;
(1.5.1-1)

Or, if these reactions between the elementary particles electrons and photons are described through their energies, taking into account that the energies W_0 and the masses m_0 of the particles and the antiparticles (for example, the electron and the positron are a particle and its antiparticle) at rest have identical values, it follows from (1.5.1-1) that:

$$W_{e0^-} + W_{e0^+} = 2.W_{e0} = m_{eo^-}.c^2 + m_{e0^+}.c^2 = 2m_{e0}.c^2 = 2W_f = 2.h.v \; ; \qquad (1.5.1-2) \text{ a}$$

$$v = \frac{m_{e0}.c^2}{h} \rightarrow \lambda = \lambda_k = \frac{c}{v} = \frac{h.c}{m_{e0}.c^2} = \frac{h}{m_{e0}.c} \; ; \text{ c) } W_\Gamma = h.v_\Gamma = 2.m_{e0}.c^2 \; ; \qquad (1.5.1-2) \text{ b}$$

where: W_{e0^-} and W_{e0^+} are the energies at rest (the internal energies) of the electron and positron; m_{eo^-} and m_{e0^+} - the masses of the electron and positron at rest; W_f - energy of photon; h - Planck's constant; v - frequency of the photon; v_Γ - frequency of the gamma photon, because in this reaction (1.5.1-1)b photons have the frequency of a gamma photon; c - velocity of light in vacuum (velocity of the electromagnetic waves in vacuum), λ_k – Compton's wave length.

Second example:

It is a well-known experimental fact that during interaction between accelerated electron e^- and positron e^+, depending on the conditions, their kinetic (magnetic) energies are restructured into protons (proton p and antiproton $\overline{p}$) or in neutrons (neutron n and antineutron $\overline{n}$) as follows:

a) $e^- + e^+ \rightarrow e_0^- + e_0^+ \rightarrow (p + \overline{p})$; b) $e^- + e^+ \rightarrow e_0^- + e_0^+ \rightarrow (n + \overline{n})$; $\qquad (1.5.1-3)$

Here it should be noted that:

1) The mass of the electron at rest m_{eo} is equal to the mass of energy W_{e0} of its electrostatic field.

a) $W_{e0} = q_e^2.k_E$; b) $k_E = (4\pi\varepsilon_0.r_{e0})^{-1}$; c) $m_{e_0} = \dfrac{W_{e0}}{c^2} = q_e^2.k_m$; d) $k_m = k_E.c^{-2}$; $\qquad (1.5.1-4)$

where: ε_0 is the dielectric constant of vacuum; r_{e0} - the computational (classical) radius of the electron.

2) The full (total) electromagnetic energy W_E of the electron at velocity $v < c$ is

a) $W_t = W_{e0} + W_{He} = m_e c^2 = m_{e0}\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}}.c^2 = m_{e0}\left(1 - \beta^2\right)^{-\frac{1}{2}}.c^2 = m_e.c^2$; b) $\beta = \dfrac{v}{c}$; $\qquad (1.5.1-5)$

where: m_e is the mass dependent on velocity, and it is

$$m_e = m_{e0}\left(1 - \beta^2\right)^{-\frac{1}{2}} \; ; \qquad (1.5.1-6)$$

and the kinetic (magnetic) energy of the electron W_{He} , since according to Maxwell, magnetic and electromagnetic energies are kinetic energies, is:

a) $W_{He} = W_t - W_{e0} = m_{e0}.c^2\left[\left(1 - \beta^2\right)^{-\frac{1}{2}} - 1\right] = q_e^2.k_m.c^2\left[\left(1 - \beta^2\right)^{-\frac{1}{2}} - 1\right] = W_{Ke}$; b) $m_{He} = \dfrac{W_{He}}{c^2}$; $\qquad (1.5.1-7)$

Here the mass gain is $\Delta m_e = \dfrac{W_{He}}{c^2} = \dfrac{W_{Ke}}{c^2}$, as a result of the mass of its magnetic (kinetic) energy at velocity v.

Then with these conditions the notation of (1.5.1-3) through the energies is:

a) $2W_{eo} + W_{He^-} + W_{He^+} = 2W_{e0} + 2.m_p.c^2$; b) $2W_{He} = W_{He^-} + W_{He^+}$ $\qquad (1.5.1-8)$

or it follows from (1.5.1-8) that:

a) $2.W_{e0} + 2.W_{He} = 2W_{e0} + 2.m_{p0}.c^2$; b) $2W_{He} = 2m_{p0}c^2$; $\qquad (1.5.1-9)$

and from (1.5.1-9) and (1.5.1-7) it follows that:

$$m_{p0} = m_{\overline{p}0} = \frac{W_{He}}{c^2} m_{e0}\left[\left(1 - \beta^2\right)^{-\frac{1}{2}} - 1\right] = q_e^2.k_m\left[\left(1 - \beta_p^2\right)^{-\frac{1}{2}} - 1\right] \; ; \qquad (1.5.1-10)$$

With an analogous procedure for the neutron (1.5.1-3)b it follows that:

$$m_{n0} = m_{\overline{n}0} = \frac{W_{He}}{c^2} m_{e0}\left[\left(1 - \beta^2\right)^{-\frac{1}{2}} - 1\right] = q_e^2.k_m\left[\left(1 - \beta_n^2\right)^{-\frac{1}{2}} - 1\right] \; ; \qquad (1.5.1-11)$$

where: $\beta_p = \dfrac{v_p}{c}$ and $\beta_p = \dfrac{v_p}{c}$, v_p and v_n are velocities of the electrons in reactions (1.5.1-3)a and (1.5.1-3)b, since protons and neutrons have different masses $m_p \neq m_n$. Moreover, the internal energies (the energies at rest) of the proton and the neutron are:

$$\text{a) } W_{p0} = m_{p0}.c^2 ; \text{ b) } W_{n0} = m_{n0}.c^2 ; \tag{1.5.1-12}$$

and they are equal to the respective magnetic (kinetic) energies of the electron or the positron, i.e.

$$\text{a) } W_{He} = W_{ke} = W_{p0} = m_{p0}.c^2 ; \text{ b) } W_{He} = W_{ke} = W_{n0} = m_{n0}.c^2 ; \tag{1.5.1-13}$$

And vice versa - the masses at rest of the proton and neutron are equal to the masses of the magnetic (kinetic) energies of the electron or positron:

$$\text{a) } m_{p0} = \dfrac{W_{He}}{c^2} ; \text{ b) } m_{n0} = \dfrac{W_{He}}{c^2} ; \tag{1.5.1-14}$$

The regularities described above are experimentally confirmed, which fact implies that these regularities are axiomatic truths - axioms. Because of this circumstance, it ought to be made clear that the analysis and the conclusions drawn from the axioms are logically well grounded, i.e. they are reliable.

Under these conditions, when replacing the expression for the magnetic (kinetic) energy of the electrons in (1.5.1-10) and (1.5.1-11) by W_{He} from (1.5.1-7), we have these formulae for the masses m_{p0} and m_{n0} :

$$m_{p0} = \dfrac{W_{He}}{c^2} = m_{e0}\left[\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}} - 1\right] = q_e^2\left[\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}} - 1\right].k_m = Q_p^2.k_m ; \tag{1.5.1-15}$$

$$m_{n0} = \dfrac{W_{He}}{c^2} = m_{e0}\left[\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}} - 1\right] = q_e^2\left[\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}} - 1\right].k_m = Q_n^2.k_m ; \tag{1.5.1-16}$$

It is apparent from (1.5.1-7), (1.5.1-9), (1.5.1-10) and (1.5.1-11) that the magnetic energies of electrons (electron and positron) have been restructured (transformed) into masses of proton and neutron. This is the theoretical ground of the well-known experimental facts, described by (1.5.1-3) a and (1.5.1-3) b.

We introduce the notions of squares of integral or effective electric charges of proton Q_p^2 and neutron Q_n^2 .

$$\text{a) } Q_p^2 = q_e^2\left[\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}} - 1\right]; \text{ b) } Q_n^2 = q_e^2\left[\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}} - 1\right]; \tag{1.5.1-17}$$

The reason to introduce these effective electric charges is the circumstance that:

First. The terms $\left[\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}} - 1\right]$ are dimensionless values;

Second. The electric charges are quantized variables in their values, and

Third. Since from the electromagnetic energy of the gamma photons γ_Γ during collision into the atomic nucleus, the electrons e_0^- and e_0^+ are generated, i.e.

$$\text{a) } \gamma_\Gamma \rightarrow e_0^- + e_0^+ ; \text{ b) } e_0^- + e_0^+ \rightarrow 2.\gamma ; \tag{1.5.1-18}$$

this fact implies by analogy that the magnetic energy of electrons can be restructured in a system of electric charges, for example:

$$\text{a) } Q_{pq} = \sum\left(\dfrac{1}{3}q_e + \dfrac{2}{3}q_e\right) ; \text{ b) } Q_{nq} = \sum\left(\dfrac{1}{3}q_e + \dfrac{2}{3}q_e\right) ; \tag{1.5.1-19}$$

It is an accepted hypothesis that in protons and neutrons there are quarks - electric charges with values $\mp\dfrac{1}{3}q_e$ and $\mp\dfrac{2}{3}q_e$, and in protons dominate the positive ones, whereas in neutrons their sum is equal to zero.

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But with the squares of the effective electric charges Q_p^2 and Q_n^2 (1.5.1-17), the sum of the squares of the quarks is always positive and greater than zero:

$$\text{a) } Q_p^2 = \sum\left(\frac{1}{3}q_e\right)^2 + \sum\left(\frac{2}{3}q_e\right)^2 > 0 \text{ ; b) } Q_n^2 = \sum\left(\frac{1}{3}q_e\right)^2 + \sum\left(\frac{2}{3}q_e\right)^2 > 0 ; \tag{1.5.1-20}$$

The constant k_m in (1.5.1-4), (1.5.1-15) and (1.5.1-16) has a numerical value:

$$k_m = \left(4\pi\varepsilon_0.r_{e0}.c^2\right)^{-1} = \left(4.\pi.8,85.10^{-12}.2,81.10^{-15}.9.10^{16}\right)^{-1} =$$

$$= \frac{1}{2,81.10^{-8}} = 3,55.10^7 \rightarrow \frac{\text{mass}}{\text{square of el. charge}} \rightarrow \frac{[kg]}{[C^2]}; \tag{1.5.1-21}$$

Here it is necessary to emphasize that the sums $Q_{p\rho}$ and Q_{mq} are not a square root of the real electric charges Q_p^2 and Q_n^2, i.e.:

$$\text{a) } Q_p \neq Q_{pq} \text{ ; b) } Q_n \neq Q_{nq} ; \tag{1.5.1-22}$$

In this sense, when the mass of an object (body) m_T is known, we can obtain the square of its effective charge:

$$\text{a) } Q_T^2 = \frac{m_T}{k_m} = m_T.2,81,10^8\left[C^2\right] \text{; b) } m_T = Q_T^2.k_m = Q_T^2.3,55.10^7; \tag{1.5.1-23}$$

but we cannot calculate the sum Q_{Tq} of its real charges.

For example:
If the real charges of a body have the sum:

$$Q_{T\rho} = -4q_e + 5q_e = 4 \text{ electrons} + 5 \text{ positrons} = 1.\, q_e , \tag{1.5.1-24}$$

the square of its effective charge is:

$$Q_T^2 = \left(-4q_e\right)^2 + \left(5q_e\right)^2 = 16q_e^2 + 25q_e^2 = 41q_e^2 ; \tag{1.5.1-25}$$

With this formulation, after we know the mass of the proton $m_p = 1,672.10^{-27}kg$ and the mass of the neutron $m_n = 1,674.10^{-27}kg$, the squares of their effective charges are:

$$Q_p^2 = m_p.k_m^{-1} = 1,672.10^{-27} : 3,55.10^7 = 4,7.10^{-34}\left[C^2\right] ; \tag{1.5.1-26}$$

$$Q_n^2 = m_n.k_m^{-1} = 1,674.10^{-27} : 3,55.10^7 = 4,715.10^{-34}\left[C^2\right] ; \tag{1.5.1-27}$$

It can be operated with these squares of the charges of the proton p and the neutron n in a similar way to the square of the charge of the electron q_e^2 when calculating the masses and the energies of the objects and any interactions whatsoever, including the emitted powers, according to paragraph 3.4 in Chapter 3.

But here, there is the significant fact that the masses and the energies of protons and neutrons are functions of the squares of the electric charges of the electrons (q_e^2).

If it is required to calculate from Q_p^2 and Q_n^2 to how many charges of the electron N_e they correspond, then the answer is:

$$N_{ep} = \frac{Q_p^2}{q_e^2} = \frac{4,7.10^{-34}}{\left(1,6.10^{-19}\right)^2} = 1,835.10^4 \text{ \textbf{effective, but not real electrons} the proton } p \text{ has}; \tag{1.5.1-28}$$

$$N_{en} = \frac{Q_n^2}{q_e^2} = \frac{4,715.10^{-34}}{\left(1,6.10^{-19}\right)^2} = 1,841.10^4 \text{ \textbf{effective, but not real electrons} the neutron } n \text{ has}; \tag{1.5.1-29}$$

When multiplying N_{ep} and N_{en} by the mass at rest of the electron m_{e0} , we obtain the masses of the proton and the neutron:

a) $m_{p0} = N_{e0}.m_{e0} = 1{,}835 \cdot 10^4 \cdot 9{,}1 \cdot 10^{-31} = 1{,}669 \cdot 10^{-26}$ kg ; $\qquad$ (1.5.1-30)

b) $m_{n0} = N_{en}.m_{e0} = 1{,}841 \cdot 10^4 \cdot 9{,}1 \cdot 10^{-31} = 1{,}676 \cdot 10^{-26}$ kg ; $\qquad$ (1.5.1-31)

The results are approximate, because here the calculations are made with 1 to 3 digits after the decimal point, and the precise data are made with more than 5 digits after the decimal point.

Under these conditions, the full energy of a body with mass m_T is:

$$\text{a) } W_T = m_T.c^2 = Q_T^2.k_m.\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}.c^2 \text{ ; b) } m_T = m_{T0}.\left(1-\beta^2\right)^{-\frac{1}{2}}; \qquad (1.5.1\text{-}32)$$

The energy of the body at rest is:

$$W_0 = m_T.c^2 = Q_T^2.k_m.c^2 ; \qquad (1.5.1\text{-}33)$$

The magnetic (kinetic) energy of the body is:

$$W_H = W_k = W_T - W_0 = Q_T^2.k_m.c^2\left[\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}-1\right] ; \qquad (1.5.1\text{-}34)$$

which is in full congruence with the quantities in the electrons.

Emphasis 1

From the known experimentally confirmed facts that:

a) during interaction of accelerated electron e^- and positron e^+ are generated protons (proton p and antiproton $\overline{p}$).

$$e^- + e^+ \rightarrow e_0^- + e_0^+ + p + \overline{p} ; \qquad (1.5.1\text{-}35)$$

b) the formula of the magnetic energy W_{ne} of the electron is

$$\text{a) } W_{ne} = m_{e0}.c^2.\left[\left(1-\beta^2\right)^{-\frac{1}{2}}-1\right] = q_e^2\left[\left(1-\beta^2\right)^{-\frac{1}{2}}-1\right].k_m.c^2; \text{ b) } \beta = \frac{v}{c} ; \qquad (1.5.1\text{-}36)$$

which is also the formula for the kinetic energy W_{ke} (1.5.1-36) of the electron, i.e. $W_{ke} = W_{ne}$.

Since the masses of the electron e_0^- and the positron e_0^+ at rest are equal $m_{e0-} = m_{e0+}$ and the masses of the proton p and the antiproton $\overline{p}$ at rest are equal $m_{p0} = m_{\overline{p}0}$, then the notation through the energies (internal $m_0.c^2$ and kinetic W_k) is

$$2m_{e0}.c^2 + W_{He-} + W_{He+} = 2m_{e0}.c^2 + 2.m_{p0}.c^2 ; \qquad (1.5.1\text{-}37)$$

whence it follows that

$$\text{a) } 2W_{He} = 2m_{p0}.c^2 \text{ ; b) } W_{ke} = m_{p0}.c^2 \text{ ; c) } m_{p0} = \frac{W_{He}}{c^2} ; \qquad (1.5.1\text{-}38)$$

i.e. the result of the experiment (1.5.1-34) proves that:

First

a) magnetic (kinetic) energy is a structural state of electromagnetic matter;

b) magnetic (kinetic) energy can be restructured (transformed) into elementary particles - protons and neutrons, etc.

Second

a) The relationship (the law) $W_{ke} = W_{ne}$ implies that kinetic energy is magnetic (electromagnetic matter), which can be restructured into substantial elementary particles - protons and neutrons.

b) protons and neutrons are electromagnetic elementary particles, since they are formed out of electromagnetic (magnetic) matter.

c) the atom and its magnetic (kinetic) energy are structures of masses and the magnetic energies of electrons, protons and neutrons, which have a square of the electric charge of the atom Q_{AT}^2 , mass m_{AT} and magnetic (kinetic) energy $W_{HA} = W_{KAT}$ at $v \ll c$ of the atom

$$\text{a) } Q_{AT}^2 = m_{AT}/k_m; \text{ b) } m_{AT} = Q_{AT}^2.k_m; \text{ c) } W_{HAT} = W_{KAT} = \frac{m_{AT}.v^2}{2} = \frac{Q_{AT}^2.k_m.v^2}{2}; \qquad (1.5.1\text{-}39)$$

d) the molecule and its magnetic (kinetic) energy, without the energy of the bond, are a structure of masses and the magnetic energies of the atoms with the square of the effective electric charge of the molecule Q_M^2, ***mass*** m_M ***and magnetic (kinetic) energy*** $W_{HM} = W_{KM}$ ***of the molecule at*** $v \ll c$

$$a)\ Q_M^2 = m_M / k_m;\ b)\ m_A = Q_M^2.k_m;\ c)\ W_{HM} = W_{KM} = \frac{m_M.v^2}{2} = \frac{Q_M^2.k_m.v^2}{2};$$

(1.5.1-40)

e) substance is an electromagnetic structure made up of a large number of molecules N, with a square of the effective electric charge Q_N^2, ***mass*** m_N ***and magnetic (kinetic) energy*** $W_{HN} = W_{KN}$ ***of the substance at*** $v \ll c$

$$a)\ Q_N^2 = m_N / k_m;\ b)\ m_N = Q_N^2.k_m;\ c)\ W_{HN} = W_{KN} = \frac{m_N.v^2}{2} = \frac{Q_N^2.k_m.v^2}{2};$$

(1.5.1-41)

5.2. Kinetic energy is magnetic energy

5.2.1. The mass of electron at rest is electrostatic mass

The electron, which is an independent negative electric charge $q_e = -1,6.10^{-19}$ C, generates electrostatic field

$$\bar{E}_e = \frac{q_e.\vec{r}_0}{4\pi\varepsilon_0.r^2};$$

(1.5.2-1)

This field has densities of electrostatic energy w_{e_0} and mass $q_e = w_e / c^2$, as follows

$$a)\ w = \frac{\varepsilon_0.E_e^2}{2} = \frac{q_e^2.\varepsilon_0}{2(4.\pi.\varepsilon_0).r^4};\ b)\ q_e = \frac{w_e}{c^2} = \frac{q_e^2.\varepsilon_0}{2.(4.\pi.\varepsilon_0)^2.c^2.r^4};$$

(1.5.2-2)

The electrostatic energies w_e and masses $m_e = m_{e0}$ of the electron are

$$W_E = \int_{r_{e0}}^{\infty} w_E.dV = \int_{r_{e0}}^{\infty} \frac{q_e^2.\varepsilon_0}{2(4.\pi.\varepsilon_0)^2.r^4}.4.\pi.r^2.dr = \frac{q_e^2}{4.\pi.\varepsilon_0.r_{e0}} = Q_{e0} = m_{e0}.c^2;$$

(1.5.2-3)

$$a)\ m_E = m_{e0} = \frac{w_E}{c^2} = \frac{q_e^2}{4.\pi.\varepsilon_0.r_{e0}.c^2} = q_e^2.k_m;\ b)\ k_m = \left(4.\pi.\varepsilon_0.r_{e0}.c^2\right)^{-1};$$

(1.5.2-4)

where: r_{e0} is computational (classical) radius of electron. I.e. the mass of the electron at rest is the mass of its electrostatic energy. Therefore, the mass of the electron at rest is electrostatic – electromagnetic, when magnetic mass is also added to it at velocity $v > 0$.

5.2.2. Magnetic energy of the electron at $m_e = m_{e0} =$ const. *and velocity* $\vec{v}$

When an electron moves at velocity $\vec{v}$ magnetic field is generated around it

$$a)\ \vec{H} = \varepsilon_0\left[\vec{v}.\bar{E}\right] = \frac{v.q_e}{4.\pi.r^2}.\left[\vec{v}_0.\vec{r}_0\right] = \frac{v.q_e}{4.\pi.r^2}.\vec{l}_0;\ b)\ \vec{l}_0 = \left[\vec{v}_0.\vec{r}_0\right];\ c)\ \vec{v}_0 = \frac{\vec{v}}{|\vec{v}|};$$

(1.5.2-5)

The densities of the magnetic energy w_H and mass ρ_H are

$$a)\ w_H = \frac{\mu_0.H^2}{2} = \frac{\mu_0.v^2.q_e^2}{2.(4.\pi)^2.r^4};\ b)\ \rho_H = \frac{w_H}{c^2} = \frac{\mu_0.v^2.q_e^2}{2.(4.\pi)^2.r^4.c^2};$$

(1.5.2-6)

The magnetic energy W_{He} and mass m_{He} of the electron at $v \ll c$ are

$$a)\ W_{He} = \int_{r_{e0}}^{\infty} w_H.dV = \frac{m_{e0}.v^2}{2};\ b)\ m_{He} = \frac{W_{He}}{c^2} = \frac{m_{e0}}{2}.\frac{v^2}{c^2} \ll m_{e0};$$

(1.5.2-7)

5.2.3. Full mass m_e and energy W_e of the electron at $v < c$

The mass of the electron is variable, which fact results from equation (1.5.1-7), where m_{He} is the magnetic mass inseparable from the mass of the electron at rest m_{e0} (1.5.1-4), i.e. when there is a magnetic mass, the mass of the electron moving at velocity $v > 0$ has a resultant value, which is a sum of m_{e0} plus m_{He}, i.e.

$$\text{a) } m_e = m_{e0} + m_{He} > m_{e0}; \text{ b) } m_e \neq \text{const.;} \tag{1.5.2-8}$$

Under this condition, the mass of the electron $m_e \neq \text{const.};$ and the momentum of the electron is

$$\vec{P}_{He} = m_e.\vec{v}; \tag{1.5.2-9}$$

And the force, which acts upon it accelerating it to velocity $\vec{v}$ is

$$\text{a) } \vec{F}_e = \frac{d\vec{P}_{He}}{dt} = m_e.\frac{d\vec{v}}{dt} + \vec{v}.\frac{dm}{dt} = \left(m_{e0} + m_{He}\right).\frac{d\vec{v}}{dt} + \vec{v}.\frac{dm_{He}}{dt}; \text{ b) } \frac{dm_{e0}}{dt} = 0; \tag{1.5.2-10}$$

The differential of electromagnetic energy dW_e for the action of force $\vec{P}$ along distance $d\vec{r} = \vec{v}.dt$ is

$$dW_e = \vec{F}_e.d\vec{r} = \frac{1}{2}.m_e.d.\left(v^2\right) + v^2.dm_e; \tag{1.5.2-11}$$

And the differential of the electromagnetic mass of the electron is

$$dm_e = \frac{dW_e}{c^2} = \frac{1}{2}m_e.d\left(\frac{v^2}{c^2}\right) + \left(\frac{v^2}{c^2}\right).dm_e = -\frac{1}{2}.m_e d\left(1-\beta^2\right) + \beta^2.dm_e; \beta = \frac{v}{c}; \tag{1.5.2-12}$$

or

$$dm_e\left(1-\beta^2\right) = -\frac{1}{2}.m_e.d\left(1-\beta^2\right); \tag{1.5.2-13}$$

or

$$\frac{dm_e}{m_e} = -\frac{1}{2}\frac{d\left(1-\beta^2\right)}{\left(1-\beta^2\right)};$$

The solution to this equation is under the following boundary conditions

$$\text{a) } v = 0 \rightarrow m_e = m_{e0}; \text{ b) } v \neq 0 \rightarrow m_e = m_v \neq m_{ev}; \tag{1.5.2-14}$$

Hence it follows for the electromagnetic mass m_e and the full electromagnetic energy W_e of the electron

$$\text{a) } m_e = m_{e0}\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}; \text{ b) } W_e = m_e.c^2 = m_{e0}.c^2\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}; \tag{1.5.2-15}$$

In these m_e and W_e are included the mass and energy of the electron at rest, respectively m_{e0} (1.5.2-11) and the internal (electrostatic) energy (1.5.2-10) $W_{e0} = m_{e0}.c^2$, whereas only the magnetic masses and energy of the electron at velocity v are

$$\text{a) } m_H = m_e - m_{e0} = m_{e0}\left[\left(1-\beta^2\right)^{-\frac{1}{2}} - 1\right]; \text{ b) } W_H = m_H.c^2 = m_{e0}.c^2.\left[\left(1-\beta^2\right)^{-\frac{1}{2}} - 1\right]; \tag{1.5.2-16}$$

5.2.4. Full mass m_T and energy W_T of electrically neutral bodies

5.2.4.1. On condition that the mass of a body at rest is $m_T = m_{T0}$ and the velocity is $v \ll c$

To an electrically neutral body of mass m_{T0} at rest, i.e. $m_{T0} = \text{const.}$, corresponds a square of its effective electric charge

a) $Q_{T0}^2 = \dfrac{m_{T0}}{k_m}$; b) $k_m = \left(4.\pi.\varepsilon_0.r_{e0}.c^2\right)^{-1}$; c) $m_{T0} = Q_{T0}^2.k_m$; $\qquad$ (1.5.2-17)

At velocity $v \ll c$, to this charge Q_T^2 corresponds a generated magnetic field

$$\text{a) } \vec{H}_T = \varepsilon_0\left[\vec{v}.\vec{E}_T\right]; \text{ b) } \vec{E}_T = \dfrac{Q_T.\vec{r}_0}{4.\pi.\varepsilon_0.r^2}; \qquad (1.5.2\text{-}18)$$

And density of magnetic energy w_{TH} and mass ρ_H

$$\text{a) } w_{TH} = \mu_0.\dfrac{H_T^2}{2} = \dfrac{\mu_0.v^2.Q_{T0}^2}{\left(4.\pi\right)^2.r^4}; \text{ b) } \rho_H = \dfrac{w_{TH}}{c^2}; \qquad (1.5.2\text{-}19)$$

The magnetic energy W_{TH} and mass m_{TH} of the body are

$$\text{a) } W_{TH} = \int w_{TH}.dV = \dfrac{m_{T0}.v^2}{2}; \text{ b) } m_{TH} = \dfrac{W_{TH}}{c^2} = \dfrac{m_{T0}.v^2}{2.c^2}; \qquad (1.5.2\text{-}20)$$

5.2.4.2. At variable mass $m_T \neq$ const. of the body at velocity $v < c$

It is evident from m_{T0} and m_{TH} (1.5.1-32) that at velocity $v > 0$, the mass of the body increases from m_{T0} at rest, by the mass m_{TH} of the magnetic field, which is inseparable from m_{T0}, respectively from Q_{T0}^2, since the resultant mass is

$$\text{a) } m_{TP} = m_{T0} + m_{TH} > m_{T0}; \text{ b) } m_{TP} = m_T \neq \text{const.}; \qquad (1.5.2\text{-}21)$$

On condition m_T (1.5.2-20) and velocity $v < c$, to the body also corresponds a magnetic mass, moreover, the mass at rest $m_{T0} = Q_{T0}^2.k_m$ is itself electromagnetic, that is why to it corresponds electromagnetic momentum

$$\text{a) } \vec{P}_{TH} = \dfrac{dW_{TH}}{dv}.\vec{v}_0 = m_T.\vec{v}; \text{ b) } \vec{v}_0 = \dfrac{\vec{v}}{|\vec{v}|} \qquad (1.5.2\text{-}22)$$

The electromagnetic force, which corresponds to $\vec{P}_{TH}$ is

$$\text{a) } \vec{F}_{TH} = \dfrac{d\vec{P}_{TH}}{dt} = m_T.\dfrac{dv}{dt} + v\dfrac{dm_T}{dt}; \text{ b) } \dfrac{dm_T}{dt} = \dfrac{d\left(m_{T0} + m_{TH}\right)}{dt} = \dfrac{dm_{TH}}{dt}; \qquad (1.5.2\text{-}23)$$

Since $m_{T0} = $ const., its derivative $\dfrac{dm_{T0}}{dt} = 0$.

The differential of the electromagnetic energy of a body with mass m_T is

$$dW_T = \vec{F}_{TH}.d\vec{r} = \dfrac{1}{2}.m_T.d\left(v^2\right) + v^2.dm_T; \qquad (1.5.2\text{-}24)$$

And the differential of the electromagnetic mass of a body with mass m_{T0} at rest, at velocity $v < c$ is

$$dm_T = \dfrac{dW_T}{c^2} = \dfrac{1}{2}m_T d\left(\dfrac{v}{c}\right)^2 + \left(\dfrac{v}{c}\right)^2 dm_T = -\dfrac{1}{2}m_T.d\left(1-\beta^2\right) + \beta^2.dm_T; \beta = \dfrac{v}{c}; \qquad (1.5.2\text{-}25)$$

or

$$\text{a) } dm_T\left(1-\beta^2\right) = -\dfrac{1}{2}.m_T\left(1-\beta^2\right); \rightarrow \text{ b) } \dfrac{dm_T}{m_T} = \dfrac{d\left(1-\beta^2\right)}{\left(1-\beta^2\right)}; \qquad (1.5.2\text{-}26)$$

The solution to equation (1.5.2-26) is under the following boundary conditions

$$\text{at a) } v = 0 \rightarrow m_T = m_{T0}; \quad \text{b) } v \neq 0 \rightarrow m_T = m_T \neq m_0; \tag{1.5.2-27}$$

Hence, the full electromagnetic mass m_T of a body with mass at rest m_{T0} (1.5.2-27)c, at velocity $v < c$ and the full electromagnetic energy W_T are

$$\text{a) } m_T = m_{T0}\left(1 - \beta^2\right)^{-\frac{1}{2}} = Q_T^2 . k_m . \left(1 - \beta^2\right)^{-\frac{1}{2}};$$

$$\text{b) } W_T = m_T . c^2 = m_{T0} . c^2 \left(1 - \beta^2\right)^{-\frac{1}{2}} = Q_{T0}^2 . k_m . \bar{c}^2 . \left(1 - \beta^2\right)^{-\frac{1}{2}}; \tag{1.5.2-28}$$

Here in (1.5.2-28)a the mass m_T is a sum of the mass at rest m_{T0} plus the mass m_{TH} of the magnetic energy $\dfrac{W_{TH}}{c^2} = m_{TH}$. Under these conditions, the mass only of the magnetic energy (magnetic mass) is

$$m_{TH} = m_T - m_{T0} = m_{T0} . \left[\left(1 - \beta^2\right)^{-\frac{1}{2}} - 1\right]; \tag{1.5.2-29}$$

And the magnetic energy of a body with mass at rest m_{T0} and velocity v is

$$W_{TH} = W_T - W_{T0} = m_{T0} . c^2 . \left(1 - \beta^2\right)^{-\frac{1}{2}} - m_{T0} . c^2 = m_{T0} . c^2 . \left[\left(1 - \beta^2\right)^{-\frac{1}{2}} - 1\right]; \tag{1.5.2-30}$$

5.2.5. Kinetic energy $\mathbf{W_{ke}}$ and mass $\mathbf{m_{ke}}$ of the electron at

5.2.5.1. $m_e = m_{e0} = $ const.
The momentum of the electron is

$$\vec{P}_e = m_{e0} . \vec{v}; \tag{1.5.2-31}$$

The force, which imparts velocity v is

$$\vec{F}_k = \frac{d\vec{P}_e}{dt} = m_{e0} . \frac{d\vec{v}}{dt}; \tag{1.5.2-32}$$

The differential of the kinetic energy is

$$dW_{Ke} = \vec{F}_k . d\vec{r} = m_{e0} . \frac{d\vec{v}}{dt} . \vec{v} . dt = m_{e0} . \vec{v} . d\vec{v}; \tag{1.5.2-33}$$

The full kinetic energy and mass of the electron are

$$\text{a) } W_{Ke} = \int_0^V dW_k = \frac{m_{e0} . v^2}{c}; \quad \text{b) } m_k = \frac{W_{Ke}}{c^2} = \frac{m_{e0} . v^2}{2 . c^2} \ll m_{e0}; \tag{1.5.2-34}$$

5.2.5.2. $m_e \neq $ const. $> m_{e0}$ – variable mass
The momentum is

$$\vec{P}_e = m_e . \vec{v}; \tag{1.5.2-35}$$

The force is

$$\vec{F}_K = \frac{d\vec{P}}{dt} = m_e . \frac{d\vec{v}}{dt} + \vec{v} . dm_e; \tag{1.5.2-36}$$

The differential of the full energy of the electron

$$dW_K = \vec{F}_K . d\vec{r} = \frac{1}{2} m_e d\left(v^2\right) + v^2 . dm_e; \tag{1.5.2-37}$$

$$dm_e = \frac{dW_K}{c^2} = \frac{1}{2} m_e . d\left(\beta^2\right) + \beta^2 . dm_e = -\frac{1}{2} m_e . d\left(1 - \beta^2\right) + \beta^2 . dm_e; \tag{1.5.2-38}$$

or

a) $dm_e.\left(1-\beta^2\right) = -\frac{1}{2} m_e.d\left(1-\beta^2\right)$; b) $\dfrac{dm_e}{m_e} = \dfrac{d\left(1-\beta^2\right)}{\left(1-\beta^2\right)}$;   (1.5.2-39)

The solution to this equation is under the following boundary conditions

a) $v = 0 \rightarrow m_e = m_{e0}$; b) $v \neq 0 \rightarrow m_e = m_e \neq m_{e0}$; c) $m_e = m_{e0}\left(1-\beta^2\right)^{-\frac{1}{2}}$;

d) $W_e = m_e.c^2 = m_{e0}.c^2\left(1-\beta^2\right)^{-\frac{1}{2}}$;   (1.5.2-40)

In this full energy is also included the energy at rest W_{e0}, which is a product of the mass m_e (1.5.2-40)a at $\beta = 0$, i.e. $m_e = m_{e0}$ multiplied by c^2

$$W_{e0} = m_{e0}.c^2;$$ (1.5.2-41)

Hence, we have for the kinetic energy W_K and kinetic mass m_K

a) $W_K = W_e - W_{e0} = m_{e0}.c^2\left[\left(1-\beta^2\right)^{-\frac{1}{2}} - 1\right]$; b) $m_K = \dfrac{W_K}{c^2} = m_{e0}.\left[\left(1-\beta^2\right)^{-\frac{1}{2}} - 1\right]$;   (1.5.2-42)

5.2.6. Kinetic energy of a body with mass at rest m$_{T0}$

5.2.6.1. On condition that $m_{T0} = m_T = $ const. and velocity $v \ll c$

The solution is analogous to the solution in paragraph 5 and case 5.1., where instead of the mass of the electron m_{e0}, the mass of the body m_{T0} at rest is placed.

The kinetic energy and the mass of the body are

a) $W_{KT} = W_{Ke} = \dfrac{m_{T0}.v^2}{2}$; b) $m_{KT} = \dfrac{W_{KT}}{c^2} = \dfrac{m_{T0}.v^2}{2.c^2}$;   (1.5.2-43)

5.2.6.2. On condition that the mass of the body m_T is variable $m_T \neq$ const.

Here too the solution is the same as for the electron in paragraph 5.2.5.2.
The full mass and energy of the body are analogous to (1.5.2-40)

a) $m_T = m_{T0}.\left(1-\beta^2\right)^{-\frac{1}{2}}$; b) $W_e = m_T.c^2 = m_{T0}.c^2.\left(1-\beta^2\right)^{-\frac{1}{2}}$;   (1.5.2-44)

And the kinetic energy and its respective mass are analogous to (1.5.2-42), as follows

a) $W_K = W_e - W_{T0} = m_{T0}.c^2.\left[\left(1-\beta^2\right)^{-\frac{1}{2}} - 1\right]$; b) $m_K = \dfrac{w_K}{c^2} = m_{T0}.\left[\left(1-\beta^2\right)^{-\frac{1}{2}} - 1\right]$;   (1.5.2-45)

5.2.7. Inference
The fact that magnetic field and its energy and mass appear only in the presence of motion of electric charges, which essentially are energy and mass of electromagnetic matter, is the reason why this energy is assessed as kinetic energy and mass.

Einstein in the article "Consideration concerning the Fundaments of Theorical Physics. Science 1940 wrote: "But J.J. Thomson showed that according to Maxwell's theory, an electrically charged body in motion has a magnetic energy, which manifests itself as kinetic energy.

5.2.8. Conclusion
Indeed, since the unitary matter of the World (Nature) is only electromagnetic matter, whose theoretical foundations are given by Maxwell, then it holds true the written in paragraph 638 of "Treatese on electricity and magnetism" by Maxwell in 1873, *"We must consider both magnetic, and electromagnetic energies as kinetic energies ".*

The obtained above results coincide with some of the special theory of relativity, but are proved only on the basis of the classical electrodynamics of Maxwell of 1873 and by using only Galileo's transformations, described by Isaac Newton in 1687 And since they are obtained with fewer initial formulations (without the postulate of constancy of the velocity of light and without Lorentz transformations), according to the principle of simplicity (Occam's razor), they are more perfect, and with this the approach is also more reliable. **And since they explain the gain of the mass and its magnetic energy, these results provide a more in-depth analysis, i.e. this solution is preferable,** *since it simplifies the physical laws and clarifies the physical meaning of mass gain.*

6. THE NOTIONS OF VELOCITY AND ACCELERATION

The notions of velocity and acceleration in Newtonian electrodynamics, and in dynamics in general as a section of physics, have meaning only if, when we take into account the fact that they are manifestations of matter (mass) and they do not exist as independent quantities which are not related to a moving material object, i.e. the velocities are components of the momentums of the bodies, which are relatively independent objects, but their velocities are not independent. In this sense, the notion of velocity $\vec{v}$ *(dynamic velocity) is inseparable from the notion of momentum* $\vec{P}$*, which is equal to the product of the quantity of matter (mass) of the body, which moves at velocity* $\vec{v}$*, i.e.*

$$\text{a) } \vec{P} = m.\vec{v}; \quad \text{b) } \vec{v} = \frac{\vec{P}}{m} = \vec{P}_0; \quad \text{c) } \vec{P} = \vec{P}_0.m; \tag{1.6-1}$$

because in dynamics, there is no velocity $\vec{v}$ **without a momentum** $\vec{P}_0 = m.\vec{v}$

$$\vec{P} = \vec{P}_0.m = \frac{\vec{P}}{m}.m; \tag{1.6-2}$$

i.e. there is no velocity which is not related to an object with mass $m \neq 0$**, which moves at velocity** $\vec{v}$**. I.e. the velocity** $\vec{v}$ **as numerical value is momentum** P_0 **per a unit of mass**

$$\vec{v} = \vec{P}_0 = 1.\vec{v}; \tag{1.6-3}$$

Because of this circumstance, at high velocities

$$\text{a) } v < c; \rightarrow \text{ b) } m = m_0\left(1-\beta^2\right)^{-\frac{1}{2}}; \quad \text{c) } \beta = \frac{v}{c} < 1; \tag{1.6-4}$$

the mass m is function of the velocity v, since the electric charge generates magnetic energy, which has magnetic mass.

Where at

$$\text{a) } v = 0; \rightarrow m = m_0; \quad \text{b) } v > 0 \rightarrow m = m_0.\left(1-\beta^2\right)^{-\frac{1}{2}} > m_0; \tag{1.6-5}$$

And the momentums are

$$\text{a) } v = 0; \rightarrow \vec{P} = m.0 = 0; \quad \text{b) } \vec{P} = m.\vec{v} = m_0.\left(1-\beta^2\right)^{-\frac{1}{2}}.\vec{v}; \tag{1.6-6}$$

And the velocities are

$$\text{a) } v = \frac{\vec{P}}{m_0} = \frac{0}{m_0} = 0; \quad \text{b) } \vec{v} = \frac{\vec{P}}{m} = \frac{\vec{P}}{m_0}.\left(1-\beta^2\right)^{+\frac{1}{2}} = \vec{P}_0\left(1-\beta^2\right)^{+\frac{1}{2}}; \tag{1.6-7}$$

Proceeding from the condition that force $\vec{F}$ is parallel to velocity $\vec{v}$, it follows that

$$\text{a) } \vec{F} = \frac{d\vec{P}}{dt} = \frac{d\left[m_0\left(1-\beta^2\right)^{-\frac{1}{2}}.\vec{v}\right]}{dt} = m_0.\left(1-\beta^2\right)^{-\frac{3}{2}}.\frac{d\vec{v}}{dt}; \rightarrow \text{ b) } \left(1-\beta^2\right)^{-\frac{3}{2}}.d\vec{v} = \frac{\vec{F}}{m_0}.dt; \tag{1.6-8}$$

After multiplying (1.6-8)b by dt and integrating respectively from zero v and from zero to t we have

$$\int_0^v \left(1 - \frac{v^2}{c^2}\right)^{-\frac{3}{2}}.dv = \int_0^t \frac{F}{m_0}.dt; \tag{1.6-9}$$

$$\text{a) } v \cdot \left(1 - \beta^2\right)^{-\frac{1}{2}} = \frac{F}{m_0} \cdot t; \rightarrow \text{ b) } v = \frac{F}{m_0} \cdot t \cdot \left[1 + \left(\frac{F \cdot t}{m_o \cdot c}\right)^2\right]^{-\frac{1}{2}}; \tag{1.6-10}$$

Hence, at low velocities

$$\text{a) } v \ll c; \text{ b) } \beta = \frac{v}{c} \rightarrow 0; \text{ c) } \frac{F \cdot t}{m_0} \ll c; \tag{1.6-11}$$

it follows that

$$\vec{P} = m_0 \cdot \vec{v}; \tag{1.6-12}$$

And at velocities

$$\text{a) } v < c; \text{ b) } \beta = \frac{v}{c} < 1; \tag{1.6-13}$$

the velocity is

$$\text{a) } v = c \cdot \frac{F \cdot t}{m_0} \cdot \left[1 + \left(\frac{Ft}{m_0}\right)^2\right]^{-\frac{1}{2}} = c \cdot \left[1 + \left(\frac{c}{\frac{F}{m_0} \cdot t}\right)^2\right]^{-\frac{1}{2}} = f_0 \cdot t \cdot \left(1 - \beta^2\right)^{-\frac{1}{2}} = \vec{P}_0 \cdot \left(1 - \beta^2\right)^{+\frac{1}{2}};$$

$$\tag{1.6-14}$$

$$\text{b) } \vec{P}_0 = f_0 \cdot t;$$

which at

$$\text{a) } t \rightarrow \infty; \rightarrow \text{ b) } v = c; \tag{1.6-15}$$

i.e.

$$\lim_{t \to \infty} v = c; \tag{1.6-16}$$

but this result is practically unrealizable since the mass at $v = c$, tends to infinity.

$$m = \frac{m_0}{\left(1 - \frac{v^2}{c^2}\right)^{\frac{1}{2}}} = \frac{m_0}{0} = \infty; \tag{1.6-17}$$

The expression of the force

$$\text{a) } \vec{F} = m_0 \left(1 - \beta^2\right)^{-\frac{3}{2}} \cdot \frac{d\vec{v}}{dt} = m_0 \cdot \gamma^3 \cdot \frac{d\vec{v}}{dt} = m_0 \cdot \gamma^3 \cdot a_k; \text{ b) } \vec{a}_k = \frac{d\vec{v}}{dt}, \tag{1.6-18}$$

entails that the differential of the velocity is

$$\text{a) } d\vec{v} = \frac{\vec{F}_0}{m_0} \cdot \left(1 - \beta^2\right)^{\frac{3}{2}} \cdot dt = f_0 \cdot \left(1 - \beta^2\right)^{\frac{3}{2}} \cdot dt; \text{ b) } \frac{d\vec{v}}{dt} = f_0 \cdot \left(1 - \beta^2\right)^{\frac{3}{2}} \neq \vec{a}_k \tag{1.6-19}$$

After integrating $d\vec{v}$ from zero to v, respectively from zero to t, we have

$$\text{a) } \vec{v} = \vec{f}_0 \cdot t \left(1 - \beta^2\right)^{+\frac{1}{2}} = \vec{P}_0 \left(1 - \beta^2\right)^{+\frac{1}{2}} = \vec{P} = \vec{v}_d = \vec{a}_d \cdot t; \text{ b) } \vec{a}_d = f_0 \left(1 - \beta^2\right)^{+\frac{1}{2}}; \tag{1.6-20}$$

At velocity $v \ll c$ (1.6-11), the velocity is

$$\text{a) } \vec{v} = \vec{P}_0 = \vec{f}_0 \cdot t = \frac{F}{m_0} \cdot t; \text{ b) } \vec{a}_k = \vec{f}_0; \tag{1.6-21}$$

where: $\vec{a}_k$ is the kinematic acceleration; $\vec{a}_d$ is the dynamic acceleration, which:

A. At velocity $v \ll c \left(\beta = \frac{v}{c} \rightarrow 0\right)$, i.e. in classical mechanics (electrodynamics) $\vec{a}_d$ is reduced to

$$\vec{a}_d = \vec{f}_0 \cdot \left(1 - \beta^2\right)^{-\frac{1}{2}} = \vec{f}_0 = \frac{d\vec{v}}{dt} = \vec{a}_k; \tag{1.6-22}$$

B. At velocity $v < c \left(\beta = \frac{v}{c} < 1\right)$, i.e. in Newtonian electrodynamics, it is

$$\vec{a}_d = \vec{f}_0 \cdot \left(1 - \beta^2\right)^{-\frac{1}{2}}; \tag{1.6-23}$$

It is apparent here that at $v = c$, $\vec{a}_d$ is annulled, i.e. the maximum velocity is limited, which fact is seen also from the value of the velocity and from the value of the mass.

Distance r, covered (at $\vec{a}_k = f_0 = \text{const.}$) for time t is

$$\text{a) } \vec{r} = \vec{v}.t = \vec{f}_0.t; \text{ b) } d\vec{r} = \vec{v}.dt = \frac{\vec{F}}{m_0}.dt = \vec{f}_0.dt; \tag{1.6-24}$$

whence formally, the velocity, which is essentially the momentum per a unit of mass is

$$\vec{v} = \frac{d\vec{r}}{dt} = \frac{\vec{F}}{m_0}.t = \vec{f}_0.t; \tag{1.6-25}$$

This linear relationship is only at low velocities.

On condition $v < c$ (1.6-13) the relationship between the covered distance r_d depending on the velocity is

$$\vec{r}_d = \vec{v}_d.t = \vec{P}.t = \vec{f}_0.t\left(1 - \beta^2\right)^{+\frac{1}{2}} \neq r = f_0.t = \frac{\vec{F}}{m_0}.\frac{t^2}{r}; \tag{1.6-26}$$

or

$$\text{a) } \frac{r_d}{r} = \left(1 - \beta^2\right)^{-\frac{1}{2}}; \text{ b) } \frac{v}{v_d} = \left(1 - \beta^2\right)^{-\frac{1}{2}}; \tag{1.6-27}$$

I.e. the ratio $r_d\big/r$ entails

$$\vec{r}_d = \frac{\vec{r}}{\left(1 - \beta^2\right)^{\frac{1}{2}}} = \vec{r}\left(1 - \beta^2\right)^{+\frac{1}{2}} \neq r = vt; \tag{1.6-28}$$

or

$$\frac{dr_d}{dt} = v_d = v.\left(1 - \beta^2\right)^{+\frac{1}{2}} \neq \frac{dr}{dt}; \tag{1.6-29}$$

I.e. the velocity v_d, when it is a high velocity

$$\text{a) } 0 \ll v_d \ll c; \text{ b) } \beta = \frac{v}{c} < 1; \tag{1.6-30}$$

is not equal of the derivative of the distance (pathway) relative the time, since is not in linear relationship of distance and time.

This fact shows that the kinetic method, which is used in modern physics to define acceleration and the velocity of motion is not correct when defining high velocities $v < c$ (1.6-13) and accelerations.

Moreover, high velocities and accelerations at low velocities, i.e. on condition

$$\text{a) } v \ll c; \text{ b) } \beta = \frac{v}{c} \to 0; \tag{1.6-31}$$

are transformed (converted) into a simplified (approximate) form, corresponding to their kinetic values, i.e. into classical velocities and accelerations.

Inferences

1. Newtonian electrodynamics (relativist electrodynamics), which is also experimentally confirmed, holds true for motion of all material objects, at micro and macro levels, at all velocities lower than the velocity of electromagnetic waves (light) $v < c$, i.e. both at low $(v \ll c)$ and high $(0 \ll v < c)$ velocities.

IN THIS SENSE THE NEWTONIAN ELECTRODYNAMICS IS THE MOST-GENERAL AND UNIVERSAL THEORY OF MOTION OF THE QUANTITIES OF MATTERS (MASSES).

But the historically preceding theory of motion of objects, the classical Newtonian mechanics, does not reject the above statement that Newtonian electrodynamics is a unitary (universal) theory of motion of object (bodies).

Since at low velocities

$$\text{a) } v \ll c; \text{ b) } \beta = \frac{v}{c} \to 0; \tag{1.6-32}$$

the description of the general Newtonian electrodynamics can be simplified to what is called classical Newtonian mechanics. This description is sufficiently accuracy for practice, although it is a special case of Newtonian electrodynamics, which is at velocities

$$\text{a) } v < c; \text{ b) } \beta = \frac{v}{c} < 1; \tag{1.6-33}$$

As for the accuracy of the classical mechanics (electrodynamics) compared to the Newtonian electrodynamics, two examples can be given as illustrations

A. At velocity $\qquad\qquad v_A = 3.10^6 \text{ m.s}^{-1};$ (1.6-34)

$$\text{a) } m = m_0 \left(1 - \frac{9.10^{12}}{9.10^{16}} \right)^{-\frac{1}{2}} = \frac{m_0}{0,9999} = 1,0001.m_0; \text{ b) } \frac{m}{m_0} = 1,0001; \text{ c) } \frac{\Delta m\%}{m_0} = 0,01\%; \tag{1.6-35}$$

B. At velocity $\qquad\qquad v_B = 3.10^4 \text{ m.s}^{-1};$ (1.6-36)

$$\text{a) } m = m_0 \left(1 - \frac{9.10^8}{9.10^{16}} \right)^{-\frac{1}{2}} = \frac{m_0}{0,99999999} \approx 1,00000001.m_0; \text{ b) } \frac{\Delta m\%}{m_0} = 0,0001\%; \tag{1.6-37}$$

Obviously, at velocities of 3.10^6 m.s^{-1}, the error is 0.01% which is negligibly small, but the value of the mass is always greater than the mass at rest $m > m_0$. *I.e. the claim that in the classical electrodynamics (mechanics) the mass is constant is, strictly speaking, not true, but as an estimate it is true.*

2. Since all natural phenomena result (originate) from some motion, which generates the interaction of parts (objects) of the unitary electromagnetic matter, whose laws are those of Newtonian electrodynamics, it follows that theories (sciences) about all natural phenomena (processes) have in their roots the theory of Newtonian electrodynamics. In this aspect Newtonian electrodynamics is a unitary principle – a unitary theoretical basis of the theory (science) of all natural phenomena because they result from manifestations of motion only of the unitary matter, which is electromagnetic matter.

3. The above conclusion, referred specifically to chemistry and biology, is also valid the scientific description and study of the processes of human thinking. The reasons for this conclusion is that the external object of human bodies through their senses import into it energies $W = m.c^2$ and masses $m = \frac{W}{c^2}$, which interact with the molecules (atoms) of the brain. In result of this the latter get restructured into a brain code (model) of the external object. With intracerebral interactions between codes (models), through their internal motions (fluctuations) at micro level, a relevant brain process occurs - a process of thinking. That is, generally speaking, the process of thinking. It is a process of motion of parts of brain matter. Such is also the formulation given by Nobel Prize Laureate of the fifties of the 20th century Prof. Linus Carl Pauling: "Chemical processes are electrodynamic processes at atomic and molecular level."

Emphasis

The main initial laws about the interaction between macro objects and microobjects were formulated by Isaac Newton. He deduced them by summarizing in "Principles…" as deterministic experimental facts (empirical laws) without referring to (interpreting) the inner essence or structure of objects. He described the processes of interaction by means of notions introduced by him, such as force and the abstracted deterministic notion of mass of a homogenous in essence quantity of matter, which is in the form of a material point (without a volume, structure and without designating their nature).

Under these conditions Newton called the processes of interaction 'mechanical phenomena', respectively, 'mechanical processes'. And the quantities, by which he described the mechanical processes, he also called mechanical - mechanical force, mechanical mass, mechanical velocity, etc.

In this sense classical mechanics is formed in compliance with the principle of the homogenous essence of matter as a mechanical variable, quantity of matter, and it is called by its abstracted notion of mass, and hence the names of its manifestations (properties) as mechanical phenomena and mechanical properties. This statement is based on the fact that in mechanics no other kind of matter is

discussed in general, except for deterministic movement of objects, whereby the quantities, by which motions are described, are called mechanical phenomena and quantities. I.e. the matters of all bodies form a unitary homogenous natural whole of objects with relative independence, which are in a state of motion, and which motions are called mechanical states, as a result of the initial formulation that the process of force interaction is called a mechanical process and the quantities, with which it is described are called mechanical, such as force, mass, velocity and so on, i.e. all natural processes of motion of matter (mass) of nature are mechanical processes.

The motivation of this assertion is the fact that all interactions at the level of macro phenomena, are principally deterministic, since they are a synthesis of the deterministic micro phenomena. Their determination is grounded in the circumstances:

- natural facts (objects and phenomena) at micro level are deterministic products of homogenous initial (original) resource, called substance or substrate.

- The substance (the initial resource) of the micro objects in the form of elementary particles and their interactions can not exist in time and space without being of deterministic volume and structure with a relevant organization, which being in this form, is something, called matter, respectively elementary particles of matter, or just elementary particles, which are something deterministic.

- Every natural process essentially has two stages: **first,** in deterministic conversion of the structure of elementary particles from one into another deterministic state, and **second,** in synthesis of microphenomena of elementary particles at macro level into one or more deterministic macro systems. *The determinacy of the macro system is conditioned by the determinacy of the processes at micro level (of elementary particles), because, according to the Law of energy and mass conservation, out of non-deterministic structural elements at micro level cannot be synthesized (formed) deterministic macro-systems.* I.e. DETERMINISTIC MICROELEMENTS AND THEIR PROCESSES OF INTERACTION GENERATE DETERMINISTIC MACROPHENOMENA (PROCESS) OR THE LAW OF CONSERVATION OF THE TANDEM MATTER-ENERGY REJECTS THE POSSIBILITY OF NON-DETERMINISTIC PHENOMENA (OBJECTS) – ELEMENTARY PARTICLES.

In this sense, material macro phenomena are deterministic because they are product synthesis) of deterministic micro phenomena. Since there cannot be any synthesis out of non-deterministic phenomena, which would yield deterministic macro phenomena, as some groundless claims have it without any experimental confirmation in quantum mechanics, that the processes of interaction are probabilities, i.e. that the probabilistic processes at micro level yield deterministic macroprocesses. **This claim is contrary to the logic that the initial base (principles) is decisive for the final result. The need for determinacy of microphenomena is also motivated by the unyielding logic of the law of matter (mass) and energy conservation, which holds true for the phenomena and at micro level as well, because up to this day, there has not been presented even a single experimental fact, which would show that W. Heisenberg's inequality holds true for micro phenomena.** But despite the compelling law of energy conservation, quantum mechanics offers such solutions that allegedly do no obey the law of energy conservation, since at micro level it is, allegedly, impossible to determine simultaneously two quantities of one object (micro object) as a momentum and as a coordinate, which fact is motivated by Heisenberg's inequality, which has no experimental confirmation and therefore, there is none of reason to be considered a physical law. It is just an expression of conformist agreement between conventional scientists, where it is assumed:

$$\text{a) } \Delta x . \Delta p \geq h \text{ ; or b) } \Delta t . \Delta w \geq h \text{ ;} \tag{1.6-38}$$

where: Δx – distance, Δp – momentum; Δt – time; Δw – energy; h – Planck's constant.

For example, according to (1.6-38) a, if Δp (momentum) is measured (determined), the coordinate Δx cannot be determined. *But here the fact is not taken into account that the momentum cannot be determined without fixing the location (the coordinate), where it is determined, i.e. without Δx , i.e. this claim is disproved by the experimental fact.* Or according to (1.6-38) b, if Δw is determined, this cannot be done, if the moment of time t is not determined, when Δw is determined and the location where it has been determined.

Moreover, the determinacy of the interactions at micro level is also conditioned by the following circumstances:

- To motivate the homogenous essence of elementary particles, it is necessary to accept that they can interact with one another, it should be accepted that they are structured out of a homogenous resource - substance. And the homogenous resources (substance) with its regularities (properties) lays the basis of determinism of the manifestations (properties) and the existence of elementary particles, i.e. of the deterministic interaction at micro level at quantitatively deterministic values, according to the law of conservation.

- **The idea of substance, which is the only initial resource for the structures of elementary particles, is also the means for a deterministic synthesis of their manifestations, as a product of unitary real deterministic principle.** In this way the empirical diversity of natural objects, phenomena and processes is motivated on the basis of a unitary, genetic foundation, as an expression of structures of homogenous substantial essence. *I.e. the substantial essence is the common link in natural facts, which not only exists but is their carrier and comprises all necessary grounds (attributive properties) of their existence and their manifestations.*

- **In the framework of a scientific deterministic analysis and synthesis, the notions of substance and the law of conservation allow researchers to fully comprehend in a deterministic way the whole nature of micro and macro phenomena, both in terms of their essence and in terms of their specific realizations, as one whole.** *In this sense, matter, as a product of its substantial resource is regarded as a deterministic, self-evolving natural unitary whole (material continuum) of deterministic substance.*

- In the above sense, it follows that elementary particles and their processes of interaction should be deterministic, since:

a) They are not simple and non-deterministic elements, but they enter the processes of interaction under strictly defined deterministic conditions, and get restructure (converted) in a deterministic way into other deterministic elementary particles.

b) It is always possible that from a predetermined group of elementary particles, assumed as initial, by a suitable succession of their reactions, could be obtained a deterministic group of elementary particles.

In this sense it can be asserted that: *the most general and deepest sense of the principle of causality in the process of interaction consists in the following: every phenomenon is conditioned by another phenomenon (according to Laplace's determinism), i.e. the inner essence of matter is itself the cause of its manifestations – it is itself the carrier and generator of its own deterministic essence, which is motivated by the law of its conservation.*

In the above sense of Laplace's determinism, there is no place for quantum non-determinacy (probability) of the products of interaction of non-deterministic initial facts, i.e. ESSENTIALLY NATURAL PHENOMENA ARE NOT PROBABILISTIC, BUT DETERMINISTIC.

IN THIS WAY THE EMPIRICAL DIVERSITY OF THE HOMOGENOUS ESSENCE OF MATTER IS MOTIVATED ON THE BASIS OF A UNITARY, THEORETICAL FOUNDATION, AS AN EXPRESSION OF THE UNITARY SUBSTANTIAL ESSENCE, I.E. AS A CONSEQUENCE OF THE UNITARY SUBSTANCE – HOMOGENOUS INITIAL RESOURCE.

Therefore, in this sense, the properties of objects are determined by the number, type and spatial states of their structural elements, whereby the same quantity and type of structural elements, but in different spatial states of the elements of objects, have different properties, i.e. with a homogenous initial resource, the spatial structure of an object defines its properties, despite that the number and type of the structural elements of objects can be the same.

I.e. any modification of natural objects can occur only in interaction of some objects with other objects, under certain conditions - this is the meaning of the principle of mechanics - mechanical motion.

IN THE ABOVE SENSE, MATTER (NATURE) AS PRODUCT OF AN INITIAL HOMOGENOUSEN RESOURCE (SUBSTANCE) IS CONSIDERED AS A DEVELOPING IN ITSELF UNITARY NATURAL WHOLE (MATERIAL CONTINUUM) OF A HOMOGENOUS RESOURCE.

GENERAL CONCLUSION ON THE PLACE OF INTERACTION IN NATURE

1. Interaction is a process, which determines all micro phenomena and the macro phenomena (objects) synthesized by them as structural elements with their specific macro processes, which are an expression of the micro phenomena growing in them and between them, on the basis of the properties of their Initial resource (substance).

2. In essence, the immanent property of matter, called interaction between components (objects) is also an implicit law of its immanent property of movement (mechanical motion) in the aspect of permanent restructuring of its objects.

3. INSTEAD OF USING KINEMATIC ACCELERATION, DYNAMIC ACCELERATION SHOULD BE USED.

4. ALL NATURAL PHENOMENA AND THE PROCESS OF INTERACTION OF MACRO AND MICRO LEVEL ARE DETERMINISTIC BOTH AS OBJECTS AND IN THE PROCESS OF FORMATION F OBJECTS THROUGH THE DETERMINISTIC PROCESS OF INTERACTION, WHICH IS ALSO CONDITIONED BY THE LAW OF MASS AND ENERGY CONSERVATION.

7. CORRESPONDENCE BETWEEN THE LAWS OF NEWTONIAN ELECTRODYNAMICS AND THE LAWS OF CLASSICAL MECHANICS

This correspondence is presented in the following table:

Table 7.1

Universal laws at:	Laws of classical mechanics at:
a) $v < c$; b) $\left(-Q_T\right)^2 \neq 0$; c) $\left(+Q_T\right)^2 \neq 0$;	a) $v \ll c$ b) $\left(-Q_T\right)^2 \neq 0$; c) $\left(+Q_T\right)^2 \neq 0$;
1a. Mass: electromagnetic matter of the body	**1b. Mass: electromagnetic matter of the body**
1.1a. Of the electron at $v = 0$	1.1b. Of the electron only at $v = 0$
$m_{e_0} = \left(-q_e\right)^2 . k_m ; \; k_m = \left(4.\pi.\varepsilon_0 . r_{e_0} . c^2\right)^{-1}$	$m_{e_0} = \left(-q_e\right)^2 . k_m = const.$
1.2a. Of the electron at $v < c$	1.2b. Of the electron at $v \ll c$
$m_e = m_{e_0}\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}} = \left(-q_e\right)^2 . k_m\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}}$;	$m_e = m_{e_0} = const.$;
1.3a. Of a body at $v = 0$	1.3b. Of a body at $v = 0$
a) $m_{TO} = \left(\pm Q_T\right)^2 . k_m$; b) $\left(\pm Q_T\right)^2 = m_{TO}/k_m$;	a) $m_{TO} = m_T = \left(\mp Q_T\right)^2 . k_m$;
1.4a. Of a body at $v < c$	1.4b. Of a body at $v < c$
$m_T = m_{TO}.\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}} = \left(\pm Q_T\right)^2 . k_m . \left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}}$;	$m_T = m_{TO} = \left(\mp Q_T\right)^2 . k_m = const.$;
here $\left(\pm Q_T\right)^2 = m_{TO}/k_m$ is the square of the effective electric charge of a body with mass m_0 at $v = 0$.	here $\left(\mp Q_T\right)^2 = m_{TO}/k_m$ is the square of the effective electric charge of a body with mass m_0 at $v = 0$.
2a. Momentum	**2b. Momentum**
$\vec{P} = m_T.\vec{v} = m_{TO}.\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}}.\vec{v}$;	$\vec{P} = m_T.\vec{v} = m_{TO}.\vec{v}$;
3a. Forces	**3b. Forces**
3.1a. Motive force	3.1b. Motive force
$\vec{F} = \dfrac{dW}{dt}.\vec{r}_0 = \dfrac{\vec{v}.d\vec{p}}{v.dt} = \dfrac{d\vec{P}}{dt} = m_{TO}\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{3}{2}}.\dfrac{d\vec{v}}{dt} =$ $= m_{TO}\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{3}{2}}.\vec{a}$;	$\vec{F} = \dfrac{dW}{dt}.\vec{r}_0 = \dfrac{\vec{v}.d\vec{P}}{v.dt} = \dfrac{d\vec{P}}{dt} = m_{TO}.\dfrac{d\vec{v}}{dt} = m_{TO}.\vec{a}$;
3.2a. Force of counteraction: inertial force	3.2b. Force of counteraction: inertial force

Table 7.1. continued

$\vec{F}_i = -m_{TO} \cdot \left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{3}{2}} \cdot \vec{a}$;	$\vec{F}_i = -m_{TO} \cdot \vec{a}$;
3.3a. Forces of action and counteraction a) $\vec{F}_d + \vec{F}_i = 0$; b) $\vec{F}_i = -\vec{F}_d$.	3.3b. Forces of action and counteraction a) $\vec{F}_d + \vec{F}_i = 0$; b) $\vec{F}_i = -\vec{F}_d$.

4a. Acceleration $\vec{a}$ and velocity $\vec{v}$

4.1a. Dynamic acceleration

a) $\vec{a}_d = \dfrac{\vec{F}}{m_{TO}}\left(1 - \dfrac{v^2}{c^2}\right)^{\frac{3}{2}} = \vec{f}_0\left(1 - \dfrac{v^2}{c^2}\right)^{\frac{3}{2}}$;

b) $\vec{f}_0 = \dfrac{\vec{F}}{m_{T_0}}$;

where the physical meaning of the quantity $\vec{f}_0$ is force per unit of mass.

And the force is $\vec{F} = m_T \cdot \vec{f}_0 \cdot \left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{3}{2}}$ = mass by

the force per unit of mass $\vec{f}_0$ by $\left(1 - \dfrac{v^2}{c^2}\right)^{\frac{3}{2}}$, i.e.

the physical meaning of acceleration is a force per unit of mass f_0 . Since the expression $\left(1 - \dfrac{v^2}{c^2}\right)$ is a dimensionless number, via substituting the dimensional units of f_0 , because

the expression $\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}}$ is a dimensionless

number, we have

$f_0 = \dfrac{F}{m_T} \rightarrow \dfrac{[N]}{[kg]} = \dfrac{[J.m^{-1}]}{[kg]}$, which

dimensionality has only a dynamic meaning.

But here acceleration has a dynamic meaning, because the force participates in the dynamic law of motion of a body with mass and acceleration f_0 .

4.2a. Dynamic velocity

From the formula of the force

a) $v < c$; b) $\dfrac{v}{c} \rightarrow \text{const.}$;

$\vec{F} = m_{TO} \cdot \left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{3}{2}} \cdot \dfrac{d\vec{v}}{dt}$;

the notation of the formula of velocity is

4b. Acceleration $\vec{a}$ and velocity $\vec{v}$

4.1b. Dynamic acceleration

a) $\vec{a}_d = \dfrac{\vec{F}}{m_{TO}} = \vec{f}_0 = \dfrac{d\vec{v}}{dt} = \vec{a}_k = \dfrac{dv}{dt}$;

where the physical meaning of the quantity $\vec{f}_0$ is force per unit of mass.

And the force is $\vec{F} = m_{TO} \cdot \vec{f}_0$ mass by the force per unit of mass, i.e. the physical meaning of acceleration is a force per unit of mass f_0 .

Via substituting the quantity f_0 by the dimensional units, we have

$\vec{f}_0 = \dfrac{\vec{F}}{m} \rightarrow \dfrac{[N]}{[kg]} = \dfrac{[J.m^{-1}]}{[kg]} = \dfrac{[kg.m.s^{-2}]}{[kg]} = [m.s^{-2}]$;

which dimensionality has only a kinematic meaning, but not a dynamic meaning.

But acceleration should have a dynamic meaning, because the force takes place in the dynamic law of motion

$\vec{F} = m_{TO} \cdot \vec{a}_k = m_{TO} \cdot \dfrac{d\vec{v}}{dt} = m_{TO} \cdot \dfrac{d^2 r}{dt^2} \cdot \vec{r}_0$, whereas the

kinematic acceleration $\vec{a}_k = \dfrac{d^2 r}{dt^2} \cdot \vec{r}_0$ is without the

participation of a force, although the dynamic

acceleration is $\vec{a}_d = \dfrac{\vec{F}}{m_{TO}} = \vec{f}_0$;

4.2b. Dynamic velocity

From the formula of the force at

a) $v \ll c$; b) $\dfrac{v}{c} \rightarrow 0$;

$\vec{F} = m_{TO} \cdot \dfrac{d\vec{v}}{dt}$;

the notation of the formula of velocity is

Table 7.1. continued

$$d\vec{v} = \frac{\vec{F}}{m_T} \cdot \left(1 - \frac{v^2}{c^2}\right)^{\frac{1}{2}} \cdot dt \ ;$$

After integrating of dv within the boundaries from v, we have

$$\vec{v}_d = \frac{\vec{F}}{m_T} \cdot t = \frac{\vec{F} \cdot t}{m_T \cdot \left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}}} = \vec{f}_0 \cdot \left(1 - \frac{v^2}{c^2}\right)^{\frac{1}{2}} \cdot t = \vec{p}_d \ ;$$

where $\vec{p}_d$ is the formula of the dynamic velocity or when the dynamic velocity is notated in the form

$$\vec{v}_d = \vec{p}_d = \frac{\vec{F}}{m_T} \cdot \left(1 - \frac{v^2}{c^2}\right)^{\frac{1}{2}} \cdot t = \vec{v} \cdot \left(1 - \frac{v^2}{c^2}\right)^{\frac{1}{2}} \ ;$$

where: $\vec{f}_0 = \dfrac{\vec{F}}{m_T}$ is the force per unit

of mass $\vec{v}_d = \vec{f}_0 \cdot t$.

In this form the dynamic velocity is momentum $\vec{p}_d$ per unit of mass, i.e. in the physical meaning, dynamic velocity is a momentum per unit of mass.

4.3a. Addition of dynamic velocities
The definition of the dynamic velocity as a momentum per unit of mass describes a real situation of a body (mass), which moves and is inseparable from its velocity.
Due to this real circumstance, the addition of dynamic velocities v_{d_1} and v_{d_2} is identical to addition of momentums p_{d_1} and p_{d_2}, i.e.

$$v_{d_{1,2}} = p_{d_{1,2}} = v_{d_1} + v_{d_2} = p_{d_1} + p_{d_2} =$$

$$= \frac{v_1}{\left(1 - \frac{v_1^2}{c^2}\right)^{\frac{1}{2}}} + \frac{v_2}{\left(1 - \frac{v_2^2}{c^2}\right)^{\frac{1}{2}}} = \frac{v_1 + v_2}{1 + \frac{v_1 \cdot v_2}{c^2}} \ ;$$

This law of addition of velocities holds true for all velocities lower than the velocity of light, i.e. at $v \ll c$, but not at $v = c$.
And with the Doppler effect in force is the law

a) $v_c = \dfrac{(c+v)}{c} \cdot c = c + v \neq c$; b) $v_c \neq c$, i.e. the

velocity of light in relation to a moving observer can be higher or lower than the wave velocity of light.

5a. Energies of a body
5.1a. The internal energy of a body is
$$W_{TO} = m_{TO} \cdot c^2 \ ;$$

a) $d\vec{v} = \dfrac{\vec{F}}{m_{TO}} \cdot dt = \vec{f}_0 \cdot dt$; b) $\vec{f}_0 = \dfrac{\vec{F}}{m_{TO}} \rightarrow \left[m.s^{-1} \right]$;

After integrating of dv within the boundaries from t , we have

a) $\vec{v} = \dfrac{\vec{F}}{m_{TO}} \cdot t = \vec{f}_0 \cdot t = \vec{p}_d \rightarrow$ b) $\vec{v} = \dfrac{r}{t} \rightarrow \left[m.s^{-1} \right]$;

i.e. in the physical meaning, kinematic velocity is a distance divided by time t .

This way does not motivate the real fact that a body, which moves at velocity v is inseparable from the velocity or that there is no independent quantity of velocity without the mass of the body, which moves. On the contrary, the motivation is that the quantity of velocity is not connected with something material.

4.3b. Addition of kinematic velocities
Under these conditions, it follows that in essence the addition of kinematic velocities v is not identical to addition of momentums p_{d_1} and p_{d_2} , i.e.

a) $v_{1,2} \neq v_{d_1} + v_{d_2} = p_{d_1} + p_{d_2}$; b) $v_{1,2} = v_1 + v_2$;

Since at a) $v \ll c$; b) $\dfrac{v}{c} \rightarrow 0$ the expression

$\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}} \approx 1$ and the expression $\dfrac{v_1 \cdot v_2}{c^2} \rightarrow 0$,

i.e. $v_{d_{1,2}} = \dfrac{v_1 + v_2}{1 + 0} = v_1 + v_2$;

This law of addition of velocities $v_{1,2} = v_1 \pm v_2$ holds true only at $v \ll c$. And with the Doppler effect in force is the law

a) $v_c = \dfrac{(c \pm v)}{c} \cdot c = c \pm v \neq c$; b) $v_c \neq c$.

5b. Energies of a body
5.1b. No solution is given for the internal energy of a body

Table 7.1. continued

5.2a. The kinetic (magnetic) energy of a body is $$W_K = W_H = \int_0^v \vec{F}.d\vec{r} =$$ $$= m_{TO}.c^2.\left[\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}} - 1\right];$$	5.2b. The kinetic (magnetic) energy of a body is $$W_K = W_H = \frac{m_{TO}.v^2}{2};$$
5.3a. The full energy of a body $$W_0 = W_{TO} + W_K = m_T.c^2 =$$ $$= m_{TO}.\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}}.c^2;$$	5.3b. The full energy of a body is equal to its kinetic energy $W_0 = W_k$ Since in classical mechanics internal energy is not defined, there is no notion (quantity) of full energy.
6. Module of elasticity (of Jung) $$E_0 = \frac{F_C}{S} = \frac{force\ of\ cohesion}{surface} = \frac{Newton}{surface} =$$ $$= \frac{electromagnetic\ energy}{distance} \cdot \frac{1}{surface} =$$ $$= \frac{electromagnetic\ energy}{volume} = w_0 =$$ = density of the electromagnetic energy; P.S. The force of cohesion F_C is an electromagnetic force, according to present-day physics (this it is a fact known since the middle of the 20th c.) The same holds true for the module of Poisson, too.	**6. Module of elasticity (of Jung)** $$E_0 = \frac{F_C}{S} = \frac{force\ of\ cohesion}{surface} = \frac{Newton}{surface} =$$ $$= \frac{electromagnetic\ energy}{distance} \cdot \frac{1}{surface} =$$ $$= \frac{electromagnetic\ energy}{volume} = w_0 =$$ = density of the electromagnetic energy; P.S. The force of cohesion F_C is an electromagnetic force, according to present-day physics (this it is a fact known since the middle of the 20th c.) The same holds true for the module of Poisson, too.
7. Wave velocity a) $v = c = \left(\frac{w_0}{\rho_0}\right)^{\frac{1}{2}} = \left(\frac{W}{m}\right)^{\frac{1}{2}}$; b) $W = m.c^2$;	**7. Wave velocity** a) $v = v_0 = \left(\frac{E_0}{\rho_0}\right)^{\frac{1}{2}} = \left(\frac{w_0}{\rho_0}\right)^{\frac{1}{2}} = \left(\frac{W}{m_{TO}}\right)^{\frac{1}{2}}$; b) $W = m_{TO}.v_0^2$;
8a. Energy-mass relationship $W = m.c^2$;	**8b.Energy-mass relationship** $W = m_{TO}.v_0^2$;
9a. Wave energy in a field form of electromagnetic matter for a finite interval of time $\tau = n.\tau_0 = \frac{n}{v_0}$, or for n number of waves, i.e. along distance $r_n = n\lambda = \frac{n.c}{v_0}$ or, as the energy of the photon a) $W_{n\lambda} = n.H_\lambda.v_0 = n.H.v_0$; b) $W_f = h.v_0$; where: H e constant with dimensionality of Planck constant, h – angular momentum = length multiplied by momentum = energy multiplied by time.	9a. Wave energy of deformation mechanical waves (of waves in a material form of electromagnetic matter and of oscillating motion for a finite interval of time $\tau = n.T_0 = \frac{n}{v_0}$, or for n number of waves along distance r_n. a) $W_{n\lambda} = n.H_\lambda.v_0 = n.H.v_0$; or for one wave b) $W_s = H_\gamma.v_0$; where: H or H_λ are constants with dimensionality of Planck constant, h – angular momentum = length multiplied by momentum = energy multiplied by time.

Table 7.1. continued

10. Emission of electromagnetic power of a body with of electric charge a) for an electron $$\frac{dW}{dt} = N = \frac{2}{3} \cdot \frac{q_e^2 \cdot a^2}{c^3} \; ;$$ b) for a body of mass $m_{TO} = Q_T^2 \cdot k_m$ and the square of the effective electric charge $$Q_T^2 = m_{TO} \cdot k_m$$ $$N_T = \frac{2}{3} \cdot \frac{Q_T^2 \cdot a^2}{c^3} = \frac{m_{TO}}{k_m} \cdot \frac{a^2}{c^3} \; ;$$ here a is the acceleration. With large bodies, since the accelerations are very small, the obtained energy $W_{NT} = N_T \cdot t$ is much smaller than their kinetic energy W_{KT}, i.e. $$W_{NT} \ll W_{KT} \, .$$ That is why W_{NT} is unmeasurable experimentally and therefore W_{NT} is ignored, despite $W_{NT} > 0$.	**10. Emission of electromagnetic power of a body with a square of the effective electric charge** $$Q_T^2 = \frac{m_{T_0}}{k_m} \; ;$$ $$N_T = \frac{2}{3} \cdot \frac{Q_T^2 \cdot a^2}{c^3} = \frac{2}{3} \frac{m_{TO}}{k_m \cdot c^3} \; ;$$ here a is the acceleration with large bodies, since the accelerations are very small, the obtained energy $W_{NT} = N_T \cdot t$ is much smaller than their kinetic energy $$W_{KT} = \frac{m_O \cdot v^2}{2} \, , \text{ i.e.}$$ $$W_{NT} = W_{HT} \ll W_{KT} = \frac{m_0 \cdot v^2}{2} \; ;$$ That is why it is not measured experimentally and so W_{NT} is ignored, despite $W_{NT} > 0$.
11a. Gravitational fields and force 11.1a. of the electron The gravitational field is $$\vec{G}_e = -\frac{m_{e0} \cdot \gamma \cdot \vec{r}_0}{r^2} = -q_e^2 \cdot \frac{k_m \cdot \gamma \cdot \vec{r}_0}{r^2} < 0 \; ;$$ The gravitational force between two electrons of mass $m_{e_1} = m_{e0_2} = q_e^2 \cdot k_m$ is $$\vec{F}_{Ge} = m_{e0_1} \cdot \vec{G} \cdot \frac{m_{e0_2} \cdot \gamma \cdot \vec{r}_0}{r^2} = -\frac{(q_e)^4 \cdot k_m^2 \cdot \gamma \cdot \vec{r}_0}{r^2} < 0 \; ;$$ The gravitational fields, which correspond to the densities of masses ρ_E of its electrostatic field E and ρ_H (at $v \ll c$) of the magnetic field H are a) $\vec{G}_E = -\rho_E \cdot \frac{\gamma \cdot \vec{r}_0}{r^2} < 0$; b) $\vec{G}_H = -\rho_H \cdot \frac{\gamma \cdot \vec{r}_0}{r^2} < 0$;	**11b. Gravitational fields and force** 11.1b. of the electron The gravitational field is $$\vec{G}_e = -\frac{m_{e0} \cdot \gamma \cdot \vec{r}_0}{r^2} = -q_e^2 \cdot \frac{k_m \cdot \gamma \cdot \vec{r}_0}{r^2} < 0 \; ;$$ The gravitational force between two electrons of mass $m_{e0_1} = m_{e0_2} = q_e^2 \cdot k_m$ is $$\vec{F}_{Ge} = m_{e0_1} \cdot \vec{G}_{e_2} \cdot \frac{m_{e0_2} \cdot \gamma \cdot \vec{r}_0}{r^2} = -\frac{(q_e)^4 \cdot k_m^2 \cdot \gamma \cdot \vec{r}_0}{r^2} < 0 \; ;$$ The gravitational fields, which correspond to the densities of masses ρ_E and ρ_H of the electrostatic and the magnetic field H (at $v \ll c$) since Maxwell's electromagnetic theory belongs to classical physics are a) $\vec{G}_E = -\rho_E \cdot \frac{\gamma \cdot \vec{r}_0}{r^2} < 0$; b) $\vec{G}_H = -\rho_H \cdot \frac{\gamma \cdot \vec{r}_0}{r^2} < 0$;
11.2a. the gravitational field of a body of mass m_T and square of the effective electric charge Q_T^2 is $\vec{G}_T = -\frac{m_T \cdot \gamma \cdot \vec{r}_0}{r^2} = -\frac{Q_T^2 \cdot k_m \cdot \gamma \cdot \vec{r}_0}{r^2}$ whence it is obvious that the gravitational fields of the bodies are secondary electromagnetic fields since they are determined by $Q_T^2 > 0$, which reflects the fact that the gravitational field is unipolar. Here the sign minus means that the gravitational force is also unipolar and is only of attraction between two bodies of masses m_{T_1} and m_{T_2} $$\vec{F}_{GT} = -m_{T_1} \cdot \vec{G}_{T_2} = -\frac{m_{T_1} \cdot m_{T_2} \cdot \gamma \cdot \vec{r}_0}{r^2} =$$ $$= -\frac{Q_{T_1}^2 \cdot Q_{T_2}^2 \cdot k_m^2 \cdot \gamma \cdot \vec{r}_0}{r^2} < 0$$	11.2a. the gravitational field of a body of mass m_T and square of the effective electric charge Q_T^2 is $$\vec{G}_T = -\frac{m_T \cdot \gamma \cdot \vec{r}_0}{r^2} = -\frac{Q_T^2 \cdot k_m \cdot \gamma \cdot \vec{r}_0}{r^2}$$ whence it is obvious that the gravitational fields of the bodies are secondary electromagnetic fields since they are determined by $Q_T^2 > 0$, which reflects the fact that the gravitational field is unipolar. Here the sign minus means that the gravitational force is also unipolar and is only of attraction between two bodies of masses m_{T_1} and m_{T_2} $$\vec{F}_{GT} = -m_{T_1} \cdot \vec{G}_{T_2} = -\frac{m_{T_1} \cdot m_{T_2} \cdot \gamma \cdot \vec{r}_0}{r^2} =$$ $$= -\frac{Q_{T_1}^2 \cdot Q_{T_2}^2 \cdot k_m^2 \cdot \gamma \cdot \vec{r}_0}{r^2} < 0$$

8. FLAWS IN THE THEORY OF MOTION OF MATTER

The flaws in the theory of motion of matter consists in that, on the one hand it is assumed in physics that there is one theory of motion at very low velocities

$$\text{a) } v \ll c; \text{ b) } \beta = \frac{v}{c} \to 0; \tag{1.8-1}$$

by which theory, according to Newton, matter is only homogenous, which is obvious in "Principles..." of 1687 and in "Opticks..." of 1704, although the essence of matter at low and high velocities is the same as the essence of light, i.e. it is electromagnetic matter. However, in present-day physics it is assumed that matter in the theory of low velocities is only homogenous, but it is not discussed what specifically it is like.

On the other hand, there is relativist theory of motion at high velocities

$$\text{a) } v < c; \text{ b) } \beta = \frac{v}{c} < 1; \tag{1.8-2}$$

which is called relativist electrodynamics. However, theory essentially refers both to low and high velocities (smaller than velocity of light), and according to its creator, A. Einstein, this theory is part of the Special theory of relativity and is a consequence from Maxwell's theory of electromagnetic matter. This is evident in Einstein's article "Autobiographische" in his book "Albert Einstein – Philosopher-Scientist" ed. by P. A. Schilpp. Evanston 1945, where he wrote: "The special theory of relativity originates from Maxwell's equations." and § 10 "Dynamics of the slightly accelerated electron" in chapter II – "Electrodynamic part" in Einstein's article "Zur Elektrodynamik der beregter Körper" Ann. Phys. 1905, 17, 891 – 921.

But the formulae at very low velocities (1.8-1) are obtained from the formulae of the relativist electrodynamics at (1.8-2) by being processed into a simplified form, which corresponds to the formulae of classical dynamics, but which are essentially a specific case of the relativist electrodynamics in a simplified notation, notwithstanding that Newton deduced them from experimental facts. Under these conditions, it follows that:

First. *The formulae of classical mechanics are essentially a simplified notation or a specific case of the formulae of the relativist electrodynamics, i.e. classical mechanics is a specific case of the relativist mechanics or classical mechanics is a simplified relativist electrodynamics, because in this aspect it is a simplified theory of motion of electromagnetic matter.*

Second. Since the procedure of simplifying involves expanding the expression $\left(1-\beta^2\right)^{-\frac{1}{2}}$ into a power series and taking only the first two terms, i.e. a value smaller than $\left(1-\beta^2\right)^{-\frac{1}{2}}$, i.e. the simplified formulae or the formulae of classical mechanics have an error of Δ relative to the ones of the relativist electrodynamics in the sense that they yield smaller values, which in relative units is

$$\Delta = \frac{\left(1-\beta^2\right)^{-\frac{1}{2}} - \left(1 - \frac{1}{2}\beta^2\right)}{\left(1-\beta^2\right)^{-\frac{1}{2}}} \ll 1; \tag{1.8-3}$$

I.e. relativist electrodynamics is more accurate than classical mechanics. But the error is insignificant. For instance, at velocity of a body $v = 3.10^6$ m.s^{-1} and mass at rest m_0, its magnetic (kinetic) energy, according to relativist electrodynamics is

$$W_H = W_K = m_0.c^2.\left[\left(1-\beta^2\right)^{-\frac{1}{2}} - 1\right] \approx \frac{m_0\left(1+5.10^{-5}\right).v^2}{2} > \frac{m_0.v^2}{2}; \tag{1.8-4}$$

which is 5.10^{-5} times greater than the value according to classical mechanics, or by 0.005%.

Third. From the viewpoint of the physical interpretation of the two theories, the relativist electrodynamics has certain significant advantages, which are:

3.a. It makes it clear that bodies have internal energy, whereas in classical mechanics they do not have internal energy.

3.b. There is a field form of matter.

3.c. It clarifies that the mass of the bodies m_T is function of their velocity, because to their mass m_{T0} at rest is added the mass $m_{TH} = \dfrac{W_{TH}}{c^2} = \dfrac{W_K}{c^2}$ their magnetic (kinetic) energy $W_{TH} = W_K$, which is function of velocity and which has mass, which adds to the mass of the body at rest.

$$m_T = m_{T0} + m_{TH} = m_{T0}\left(1 - \beta^2\right)^{-\frac{1}{2}}; \qquad (1.8\text{-}5)$$

These are the reasons, which give advantage to the relativist electrodynamics, i.e. to the assumption that the initial basis (principle) of classical mechanics is the basis of relativist electrodynamics, i.e. that classical mechanics is a specific and simplified case of the relativist electrodynamics or that classical mechanics is simplified electrodynamics.

Fourth. The velocity of the body in the relativist electrodynamics is

$$\text{a) } v = \frac{c.F.t}{m_0\left[\left(\dfrac{F.t}{m_0}\right)^2 + 1^2\right]^{1/2}} = \frac{c}{\left[1 + \left(\dfrac{c.m_0}{F.t}\right)^2\right]^{1/2}}; \text{ b) } \lim_{t\to\infty} v = c; \qquad (1.8\text{-}6)$$

The velocity v, since it is inseparable from the mass – it is momentum of the body, therefore it cannot be determined as a derivative of the pathway (distance)

$$\bar{v} \neq \frac{d\bar{r}}{dt}; \qquad (1.8\text{-}7)$$

whereas in classical mechanics, where $v \ll c$, the differential of the velocity dv and the velocity v are

$$\text{a) } d\vec{v} = \vec{a}.dt = \frac{dr^2}{dt^2}.\vec{r}_0.dt; \text{ b) } \vec{v} = \frac{d\vec{r}}{dt}; \qquad (1.8\text{-}8)$$

can be determined as a derivative of the pathway (distance) relative to the time.

Brief overview of Chapter one

Introduction to the overview

The classical mechanics of Newton, as presented in "Mathematical principles ..." in 1687 is the initial principle of the science of physics, which was later developed in "Opticks ..." and in 1704 by proving the electromagnetic essence of matter of objects, which have relative independence.

*This classical mechanics is essentially the initial stage as a science of motion of objects from the substantial form of the unitary matter at low velocities v, which are much smaller than the velocity of light (of electromagnetic waves) c, i.e. $v \ll c$ or $v/c \to 0$ and that matter of the objects is homogenous. And after it was discovered that there is electromagnetic matter in substantial and field form (fields, electrical, magnetic and gravitational, and their respective masses and their energies), up to the present time no one has undertaken to make one more step forward, to establish the correlational relationship of these new facts according to the respective laws of the preceding ideas (theories) about quantities, such as mass, force, energy, etc. and to establish their unitary theoretical basis with the new facts available. **Instead, a new relativist mechanics was created, which apparently is substantially different from classical mechanics. MOREOVER, MODERN MECHANICS (CLASSICAL AND RELATIVIST) DOES NOT TAKE INTO ACCOUNT THE FULL SET OF VIEWS ON PHYSICS, PRESENTED IN NEWTON'S BOOKS "MATHEMATICAL PRINCIPLES OF NATURAL PHILOSOPHY" OF 1687 AND "OPTICKS OR A TREATISE OF THE REFLECTIONS, REFRACTIONS, INFLECTIONS AND COLOURS OF LIGHT "OF 1704, WHILE AT THE SAME TIME IT REFLECTS ONLY A PART OF J. CL. MAXWELL'S IDEAS AND CONSEQUENCES FOR THE RELATIVIST MECHANICS PRESENTED IN HIS BOOK "TREATISE ON ELECTRICITY AND MAGNETISM" OF 1873.***

*Under these conditions, here in this book, an attempt is made to set a theoretical basis of all the unitary mechanics (dynamics), which should be a general, uniting theory under the name of **Newtonian electrodynamics (mechanics)**, and which should cover both classical and relativist mechanics in accordance with what was written by Isaac Newton in "Opticks ..." from 1704, i.e. is should be the most general theory of motion of matter. Furthermore, this unitary theoretical basis must take its origin from the relativist mechanics, which is a fundamental theory for the motion of objects of electromagnetic matter in*

field and substantial forms at all velocities from zero up to c (v <c) and which grows here into the so-called Newtonian electrodynamics or mechanics. **And from the laws of the unitary theoretical basis of Newtonian electrodynamics (mechanics) are formed laws, which apply both to: a) the objects of the substantial form of electromagnetic matter, which apparently are externally electrically neutral and which move at velocities v, much smaller than the velocity of the electromagnetic waves (light)** c $(v \ll \mathrm{c}$ **or** $v/c \rightarrow 0)$, *such as the laws of classical mechanics, i.e.* **the laws of classical mechanics should be specific cases of the relativistic laws of electromagnetic matter under respective specific conditions, therefore, their solutions have a simplified notation; b) and also for the objects, which move at high velocity** $0 \ll v < c$

In this sense, the laws of gravity are also laws of electromagnetic matter, because it has been known for a long time that electromagnetic matter in the form of electrons and electromagnetic waves generates also gravitational fields and forces, which are generated by its electromagnetic mass. **The notion of mass, which was introduced by Newton, is and abstracted notion (a model for calculations) of the notion of quantity of matter in the form of a dimensionless point, i.e. without a volume V (V = 0) without a form and without any structure, placed in the center of gravity of the objects to whose quantity of matter the mass refers.** *Thus Newton simplified the mathematical equations, by which are described the laws of mechanics.*

A. The Newtonian electrodynamics is formed by (results from) the following formulations:
A.1. Methodology of classical mechanics, given by Newton;
A.2. The three basic laws of classical mechanics - The laws of Newton;
A.3. **The proof of I. Newton of 1704 in "Opticks ..." that matter is only of electromagnetic essence, i.e. that matter is only electromagnetic in substantial and field forms, by proceeding from:**
"All bodies emit and absorb light"
"Bodies turn into light, and light turns into bodies"
"These are normal natural phenomena – experimental facts"
Given that according to modern physics, light is a field form of electromagnetic matter and that in essence the summarized experimental facts (empirical laws) are logical laws, which have irresistible evidential force, it follows that the above statements in the form of experimental facts given by Newton, in an updated form are laws, which state:
"All bodies emit and absorb field electromagnetic matter".
"Bodies convert into field electromagnetic matter (electromagnetic waves), and field electromagnetic matter into electromagnetic substance."
"These are normal natural laws."
Or the unitary matter of nature is only electromagnetic in the form of substances and fields (electric, magnetic and gravitational) and their respective masses and energies.
B. Classical mechanics is a result of:
From the Newtonian electrodynamics, which essentially is a theory of electromagnetic matter,

which at much smaller velocities v than the velocity of light $v \ll c$; $\dfrac{v}{c} \rightarrow 0$ **is reduced to simplified**

formulae, which are the laws of classical mechanics.
I.e. the laws of Newtonian electrodynamics are reduced to laws of classical mechanics, which have a shorter notation.
UNDER THESE CONDITIONS, THE FULL THEORETICAL FOUNDATIONS OF CLASSICAL MECHANICS ARE ALSO THE LAWS OF NEWTONIAN ELECTRODYNAMICS, I.E. CLASSICAL MECHANICS IS A SPECIFIC CASE OF NEWTONIAN ELECTRODYNAMICS.

Emphasis

These natural laws (facts) are well-known that in each place (each point) all over the nature there are:
a) gravitational fields, which act as a force upon objects (bodies) and impart accelerations and velocities to the objects, according to the laws of the gravitation which are essentially of electromagnetic nature – gravitational structure of electromagnetic matter
b) electromagnetic fields, in the form of electromagnetic waves with different lengths or in the form of photon gas, which generate forces upon objects, respectively generate Maxwellian pressure (for instance, these forces of pressure are the forces, which decline the tails of comets, and partially of space objects), which impart accelerations and velocities to the molecules of the gas of molecules.

I.e. there exists a natural law (fact) that upon all objects in nature always and concurrently act electromagnetic and gravitational forces.

HOWEVER, DESPITE THIS NATURAL LAW, THE EQUATIONS OF THE MOTION OF BODIES ARE OFTEN NOTATED WITHOUT THE GRAVITATIONAL FORCES AND MAXWELLIAN PRESSURES, WHICH IN REALITY ALWAYS ACT UPON BODIES. THE REASON FOR THIS INCORRECTNESS IS THE CIRCUMSTANCE THAT THE QUANTITATIVE VALUES OF THE ABOVE FORCES ARE IMPLICITLY ASSUMED TO BE IGNORABLE IN RELATION TO THE PRIMARY ONES FOR THE PRIMARY ELECTROMAGNETIC PROCESSES AND THEREFORE THEY DO NOT HAVE MUCH PRACTICAL IMPORTANCE.

It is another question that there are cases with such conditions, when the gravitational forces and Maxwellian pressures are of essential importance; in such cases, they participate in the equations of the motion of bodies.

Note

The presentation herein of the laws of Einstein's theory of relativity of 1905[*] about the mass and energy at low and high velocities of motion $\left(0 < v < c\right)$ $m = m_0 \cdot \left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}}$ *, and the relationship between energy W and mass* $m \rightarrow W = m.c^2$ *is done only on the basis of the classical electromagnetic theories of Newton in "Principles..."and in "Opticks..." of 1704 and of Maxwell of 1873. Therefore, since these laws are a result of classical theories, they should be called classical laws, notwithstanding that Einstein obtained and published them on the basis of the principle of constancy of the velocity of light irrespective of the states of motion of the observer or the source of light – a principle not only without experimental confirmation, but experimentally rejected - and the Lorentz transformations in 1905*

I.e., since the inferences from the laws $m = m_0 \cdot \left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}}$ and $W = m.c^2$ are deduced herein only by using the classical laws of Newtonian electrodynamics which are confirmed by experimentally established classical premises (formulations) fewer in number than those of Einstein, which makes them more reliable and more perfect and according to what Einstein himself wrote: *"Of two theories, which equally well explain one phenomenon, this theory is more reliable and more perfect which is built on fewer premises",* they should be regarded as classical laws.

Due to the presented facts, Newtonian electrodynamics should be considered as classical electromagnetic theory, and hence Newtonian electrodynamics should be recognized as a classical science.

In the above meaning, for all dynamics, being part of physics, it should be hold that it is:

First. Classical physics

Second. *In essence, all natural phenomena are dynamic (mechanical) since in their basis, they are always (without exception) a result of the motion of matter from one to another place (matter exchange between two or more bodies), at micro level (chemical and biological processes[**]) as well as at macro- and cosmic levels.*

I.E. ALL NATURAL PHENOMENA RESULT FROM DYNAMIC (MECHANICAL) PROCESSES, RESPECTIVELY ARE MECHANICAL PROCESSES IN DIFFERENT CONDITIONS (SITUATIONS) OF ELECTROMAGNETIC MATTER – THEY ARE ELECTROMAGNETIC PHENOMENA.

The above results coincide with these in the special theory of relativity, but are deduced only on the basis of Newtonian mechanics and of Maxwell's classical electrodynamics of 1873 and by using only Galileo's transformations as described by Isaac Newton in 1687. And since they are obtained using fewer initial formulations (without the postulate of constancy of the velocity of light and without Lorentz transformations) *according to the principle of simplicity (Occam's razor) they present a more reliable proof and therefore they are more perfect than the ones of the theory of relativity.* **And since they explain the gain of mass of the electron by accretion of the mass of its magnetic energy, they give a**

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[*] Einstein, A., Zur Elektrodynamik der bewegten Körper. Ann. Phys., 1905. 17. 891 – 921.

[**] As the Nobel Prize Laureate, Prof. L.Pauling, put it, "Chemistry is electrodynamics at atom and molecular levels".

more in-depth analysis, therefore this solution should be preferred, *because it simplifies the physical laws and clarifies the physical meaning of the gain of mass (matter) of the bodies, which fact does not exist in modern physics.*

In this sense, these solutions result from classical physics. And since they are obtained with fewer initial formulations relative to the special theory of relativity (STR) according to the principle of simplicity (Occam's razor) they must be accepted for initial principle of the theory of motion and restructuring of electromagnetic matter (and for physics in general), although in this form they are first published at present time.

And instead of referring separately to classical physics and relativist electrodynamics, they should be integrated in the notion of Newtonian electrodynamics - mechanics or universal electrodynamics. This Newtonian (universal) electrodynamics (mechanics), further developed by Maxwell, Planck and others, according to Einstein is more perfect, because it deals with fewer prerequisites.

Emphases

NEWTONIAN PHYSICS IS NOT A HISTORICAL RELIC, BUT A THEORETICAL BASIS OF CONTEMPORARY AND FUTURE SCIENCE OF NATURE.

ISAAC NEWTON WAS THE FOUNDER NOT ONLY OF MODERN MECHANICS BUT ALSO OF ELECTRODYNAMICS.

HE WAS THE FIRST TO INTRODUCE THE CUMULATIVE IDEA OF UNITY, CONTINUITY AND INNER LOGIC OF KNOWLEDGE ABOUT NATURE AND NATURAL PHENOMENA.

CHAPTER TWO
NATURE OF THE NOTION OF INTERACTION

2.1. GENERAL FORMULATIONS

The notion of interaction in physics is the process illustrating (motivating) the phenomenon of restructuring of the structures of natural occurrences (NO) in result of the alteration of the quantities of matter of the interacting objects, or a force interaction occurs which alters the spatial states of the structural elements of a given object without altering their kind or number. In the section of dynamics in physics, by the notion of interaction it is understood a process-way of transfer of matter (energy) from one object to another through acceleration or alteration of the velocity of a given object under the action of force $\vec{F}$ generated by another object. But the nature of the process of setting into motion (accelerating) under the action of force $\vec{F}$ should be interpreted by taking into account the measuring unit for force, which is a Newton and which is equal to a Joule J upon a meter, i.e.

$$F \rightarrow [N] = \frac{[J]}{m} = \frac{W}{r} = \frac{\text{energy}}{\text{distance}} = W_F ; \qquad (2.1\text{-}1)$$

and by accounting for the law of relationship between energy and mass

$$W = m.c^2 ; \qquad (2.1\text{-}2)$$

where: m is mass (quantity of matter); c – velocity of light.

It follows that the dimensionality of the force is

$$[F] = \frac{\text{mass (quantity of matter)} \, . \, c^2}{\text{distance}} = m_F.c^2 ; \qquad (2.1\text{-}3)$$

I.e. the force transfers energy or mass (quantity of matter) along which it acts along a unit of distance.

THEREFORE, WHEN A NATURAL OBJECT IS ACCELERATED, QUANTITY OF MATTER (MASS) m_F AND ENERGY W_F IS IMPARTED TO IT, I.E. THE OBJECT ACTING BY FORCE F RELEASES A CERTAIN QUANTITY OF MATTER (MASS) m_F AND ENERGY W_F TO THE OBJECT UPON WHICH IT ACTS AND WHICH GETS ACCELERATED AND RESTRUCTURED BY THE FORCE. OR, IN ORDER THAT AN OBJECT COULD BE ACCELERATED AND RESTRUCTUERD, MATTER (ENERGY) SHOULD BE IMPARTED (RELEASED) TO IT. IN THIS SENSE, THE PROCESS OF ACCELERATING IS A PROCESS OF INTERACTION.

Here, with regard to object restructuring, two essential points should be taken into account:

- on the one hand, the substance (the unknown initial resource) of matter, as carrier of its potential restructuring possibilities and attributive properties remains the same in the new structures;

- on the other hand, in the process of restructuring (transformation) their structures change, their states of motion and their quantities of matter (their masses and energies), and therefore, their properties should be changed as well, including those of force interaction, i.e. the typical features of the interacting objects change.

I.e. in the process of restructuring (transformation, particles retain their substance, the possibilities for their matter to be restructured, their total energy, their mass (quantity of matter) and their electric charges, i.e. their attributive properties are preserved.

Or the structure of objects changes into one or more new objects, which determine their new forms, their specific new properties of interaction, i.e. an object attains a new, specific nature (or only nature), while retaining its substantial nature.

This substantial nature, and its connection to the attributive properties of matter, needs some additional clarification. It is clear that attributive properties are inseparable both from each other and from the notion of matter, which notion involves, in addition to them themselves, their attributive property to be able to transform from one form (structure) into another while retaining the other attributive properties of theirs. **Due to this circumstance, the substantial essences or the substantial existence (in a broad range of the notion of substance) of matter represents inseverable unity both of their attributive properties and of the properties resulting form their structures.**

I.e. the connection between the parts (fragments) is a harmonic agreement, i.e. each part has its place in the whole. Therefore, the whole (the nature) has new properties, which the independently existing parts lack, or the integration of the parts into one whole is something more than their arithmetic sum.

Nature (natural processes), as a unitary system, is a unitary, integral system motivated only by its internal forces and resources. It is only due to the properties of its parts, as independent entities and as one whole, that it can change as a material entity (natural occurrence – NO).

In the above sense, therefore, the principle of materiality lies in the foundations of knowledge, which principle states: *"In essence, nature is a unitary, homogenous, continuous and all-comprising material continuum in space and time, which is incessantly restructured and does not depend on anything external to it, but only on its own reasons (causes), i.e. nature functions only on the grounds of the properties, which are invested in it, through its initial resource".* In this sense, there is no place in nature without matter or there is not anything in it which is not material, i.e. there are no non-material parts in nature, which are not a natural occurrence. *Or everything, which is ascertained (discovered) in it (or its interpretation) is only material, there none of non-material natural occurrences (manifestations).*

I.e. the action of a force upon an object (body) is an expression of the process of exchange of matter (energy and mass) or of a sum of elementary particles , which process is an expression of the notion of interaction, used for micro objects, elementary particles, as well.

As it is well known, matter has granular (discrete) structure, which consists of tiny quantities of matter, called elementary particles, as well as of atoms and molecules which comprise elementary particles. **Because of this circumstance, exchange of matter during interaction between objects, is essentially exchange of certain quantity of elementary particles of granular (discrete) structure, whose sums of masses and energies are equal to the mass and energy, which corresponds to the interaction caused by the force, i.e.**

$$\text{force = sum of masses and energies of elementary particles;} \tag{2.1-4}$$

Since in macro processes, the value of mass m_F (2.1-3) and energy of the force W_F (2.1-1) are much greater than the values of energy W_f of the elementary particles, i.e.

$$\text{a) } m_F \gg m_f; \text{ b) } W_F \gg W_f, \tag{2.1-5}$$

Therefore, the force is an approximated characteristic of a multitude of elementary particles. And therefore, any alteration of energy and mass (quantity of matter) can be considered, during computational operations at macro level, as a continuous process whenever mass m_f energy W_f of a separate elementary particle is much smaller in value than the mass m_F and energy W_F exchanged between objects corresponding to force $F\left(W_F \equiv m_F \equiv F\right)$.

In this aspect, it turns out that each type of mass and energy at macro level is reducible to the mass and energy of the sum of elementary particles m_f and W_f at macro level

$$\text{a) } m_F = \sum m_f; \quad \text{b) } W_F = \sum W_f; \tag{2.1-6}$$

And each force F is reducible to the velocity of transmission of momentums $\vec{P}_{fi}$ of the quanta of fields $\vec{P}_f$, i.e. of photon elementary particles

$$\vec{F} = \sum \frac{d\vec{P}_{fi}}{dt_i}; \tag{2.1-7}$$

From a general viewpoint, the mechanism of the process of interaction described through force (at macro level) or through elementary particles (at micro level) looks like this.

ONE OBJECT RELEASES, THROUGH DETACHING A CERTAIN QUANTITY OF MATTER AND ENERGY OFF ITS STRUCTURE IN THE FORM OF A SUM OF ELEMENTARY PARTICLES, WHICH QUANTITY MOVES APPROXIMATELY OR MOST OFTEN, BEING FIELD PARTICLES (PHOTONS), THEY MOVE AT THE VELOCITY OF LIGHT, REACHES ANOTHER OBJECT AND ATTACHES TO ITS STRUCTURE, RENDERING ITS QUANTITY OF MATTER (MASS), ENERGY AND MOMENTUM. AS A RESULT OF THESE FACTS, ONE AND THE OTHER OBJECT GET RESTRUCTURED AS A WHOLE OR ONLY A PART OF THEM GETS RESTRUCTURED (FOR INSTANCE, WITH MACRO OBJECTS, THIS CAN BE A PARTIAL DEFORMATION).

It is evident from the presented above that the mechanism of the process of interaction is only possible on condition that the nature of the interacting objects is homogenous (electromagnetic, i.e. they are products of electromagnetic matter.

This condition fulfilled, the process of interaction is characterized by the following features:

1. The process of interaction is only possible when there is motion of interacting objects A and B or parts of matters (masses) one relative to another.

For instance, if objects A and B before the interaction had masses m_{A0} and m_{B0}, after the interaction they have masses m_A and m_B, i.e.

$$\text{a) } m_A \neq m_{A0}; \text{ b) } m_B \neq m_{B0}; \text{ c) } m_{A0} + m_{B0} = m_A + m_B; \tag{2.1-8}$$

2. For time τ_{AB} of interaction, for instance, if object A is the one acting with force F, it releases (gives off, emits) quantity of matter $\Delta m_{AB} \leq m_{A0}$, which quantity moves from object A to object B along distance r_{AB} at a relevant velocity v_{AB} and is absorbed (attached or merged) by object B.

3. As a result of this process of exchange of matter Δm_{AB}, after time τ_{AB} of the interaction, the matters (masses) of objects A and B are

$$\text{a) } m_A = m_{A0} - \Delta m_{AB}; \text{ b) } m_B = m_{B0} + \Delta m_{AB}; \text{ c) } m_A + m_B = m_{A0} + m_{B0}; \tag{2.1-9}$$

i.e. the quantities of matter of objects A and B are changed, and along with that, the number of their structural elements and spatial states also change while the law of mass and energy conservation is observed.

4. **As a result of the alteration of the structural elements in respect of their number and their location, alteration is brought upon their structural (their restructuring occurs), or their transformation into another kind of property, respectively, if the alteration is above the limit for retention of their properties, and along with this, of their characteristics.** *Because the properties of objects, as systems without their attributive properties, are explained through their structures, i.e. the whole has such properties as its parts have, whereas, as individual elements they do not have them.*

Here it should be pointed out that:

a) *the process of interaction, or formation of new structures and new objects, respectively, out of known (assigned) objects, according to the laws of conservation of matter and energy, is only possible if objects A and B, or their structural elements, respectively, are of homogenous initial resource (substance) i.e. if they have homogenous genetic unity;*

b) *the structural explanation of properties, (that properties are structurally determined), applied in aspect of the whole and its parts (structural elements) shows that the process of interaction (exchange of matter and motion (energy) between objects) is the cause of manifestation of new properties;*

c) that the process of interaction is a process of continuous motion – it is eternal and it exists in various forms;

d) that during interaction between objects, there is always motion of matter, and since the carrier and generator of this motion of matter is the entity, out of which matter is formed, which is the homogenous initial resource (substance), then it follows that this **resource (substance) is also the resource (substance) of motion and restructuring, i.e. of interaction itself.** *I.E. THE PHENOMENON MOTION IS JUST ANOTHER ESSENCE (FEATURE) OF THE INITIAL RESOURCE (SUBSTANCE). And this is actually the motivation of eternity – the eternal motion and alteration – because the resource (substance) is eternal.*

Therefore, the process of interaction (in a synthesized expression) has the following features:

- it is eternal (inalienable) attributive property of matter and is in the basis of all natural occurrences in time and space;

- it is the reason for the eternal and incessant motion of matter from one object (a whole object) to another object, which fact results in incessant alteration of quantities of matters of objects;

- the incessant and eternal alteration of the quantities of matter of objects leads to incessant restructuring (transformation) of their matters into various structural states, which fact determines the variety of their properties and characteristics and their incessant alteration;

- the matters of the various objects during interaction retain the homogenous essence of their initial resource (substance), i.e. nature is a homogenous whole – a homogenous material continuum;

*I*N THIS WAY, THE EXPLORATION OF THE EMPIRICAL NATURAL DIVERSITY IS RENDERED MEANINGFUL ON THE GROUNDS OF A UNITARY THEORETICAL BASIS, AS AN EXPRESSION OF THE UNITARY SUBSTANTIAL ESSENCE, I.E. AS A RESULT OF UNITARY SUBSTANCE.

Therefore, in this sense, the structural properties of objects are determined by the number, type and spatial states of their structural elements, whereby if the quantity and the type of the structural elements are the same, but the spatial states of the elements of the object are different, they reveal different properties, i.e. the spatial structure of an object determines its properties, regardless of the fact that the number and type of the structural elements of the objects may be the same, i.e. the properties are structurally determined.

T*HEREFORE, THE STRUCTURE AND THE STRUCTURAL ELEMENTS ARE INALIENABLE ATTRIBUTES (NATURE) OF EACH OBJECT, I.E. THERE CANNOT EXIST A REAL OBJECT WITHOUT STRUCTURAL ELEMENTS OR STRUCTURE AT A RELEVANT LEVEL OF ORGANIZATION OF MATTER, FOR WITHOUT THEM, NO UNIFIED SYSTEM, CALLED OBJECT (BODY), CAN EVER BE FORMED, NOR ANY STRUCTURAL CONNECTION OR PROPERTIES OF OBJECTS, AND IT IS ANOTHER QUESTION WHETHER IT IS ALWAYS POSSIBLE TO DETERMINE EXPERIMENTALLY WHAT THE STRUCTURE OF A GIVEN OBJECT IS.*

The principle of causality lies in the concept that each natural phenomenon is determined by another natural phenomenon (object) via the process of interaction, according to Laplace's determinism. In this sense, the principle of causality is only another expression of the principle of self-motion and restructuring of matter as its inherent activity. I.e. each alteration of natural objects can only occur during interaction of some objects with other objects, under certain conditions – and this is the meaning of the principle of materiality.

I*N THE ABOVE SENSE, MATTER (NATURE) AS PRODUCT OF THE HOMOGENOUS INITIAL RESOURCE (SUBSTANCE) IS REGARDED AS SELF-EVOLVING UNITARY NATURAL WHOLE (MATERIAL CONTINUUM) OF HOMOGENOUS RESOURCE.*

2.2. ON THE ESSENCE AND PLACE OF NEWTONIAN DYNAMICS IN SCIENCE

Evidently, it is a real fact that all natural manifestations (objects, phenomena, processes, etc.) are unconditionally a result (consequence) or are essentially a product of the process of interaction. I.e. they result from the motion of matter, at various quantitative values, from one place to another (from one object to another) at respective velocities and forces (exchange of matter and energy) between some objects and other objects. As a result of this, the values of the quantities of matters of the objects change, and, consequently, their structural states change. Due to these changes of the objects, their properties and dynamic states also undergo changes. Or in a global aspect, these processes account for the essence of their changes in a progressive or regressive evolution. *And when describing this process, it is necessary to introduce the notion of time so as to arrange the various states, in the sense of quantities of matter and energies and of structures and properties.*

The above assertions are grounded in the circumstance that in nature (material continuum) there is no place or parts without matter, at least in the form of gravitational fields or photon gas (electromagnetic fields), which do not generate interaction, i.e. there are no places without any motion of matters. *And the process of motion in its simplest forms is interpreted in the section of dynamics in physics.* *This fact states that all natural processes, which result in alteration of properties or states of matter, are consequences of a process of interaction, or of dynamic processes respectively, which are the cause of the change of the properties of the quantities and the structures of the material objects, as well as of their properties.*

In the above sense, the whole Newtonian electrodynamics should be seen as a general, initial section of the physics of all natural phenomena without any exceptions, and it should be recognized that:

First. It is classical physics

Second. *Essentially, all natural phenomena are dynamic (mechanic) since in their basis they always (without exceptions) result from motion of matters and energies from one place to another (exchange of matters between at least two objects), both at microlevel (chemical and biological processes*) and at macro- and cosmic levels.*

I.E. ALL NATURAL PHENOMENA ARE CONSEQUENCE OF DYNAMIC (MECHANIC) PROCESSES, OR OF MECHANIC PROCESSES IN VARIOUS RESPECTIVE CONDITIONS (SITUATIONS) OF ELECTROMAGNETIC MATTER – THEY ARE ELECTROMAGNETIC PHENOMENA.

Therefore, in a global sense, all natural processes are dynamic processes (phenomena), i.e. processes of motion of matters, in various conditions at micro- and macro levels, whereby physics study their simplest forms.

In this global aspect, the whole physics and the sciences of nature, such as chemistry and biology, treat dynamic processes. But in various conditions of motions and structuring of matters they are chemical, biological or other dynamics, and therefore **physics should be recognized as the leader of sciences of nature.**

In this sense, the processes of perception and thinking running in mind (cerebral matter) of living organisms, including man, are dynamic processes of transfer – motion of matters at micro level. However, due to the specific conditions, in which they develop, they are known under specific names.

Emphasis

The global meaning of the process of interaction, which, from an external point of view, is essentially a process of motion of matter from one (certain) place to another (certain) place in nature, or from one object to other relatively independent objects, is called a dynamic process in physics, and this is a fundamental principle (process) in all natural phenomena (processes), which determines the eternal (permanent) alteration of the states of matter.

In nature, there is no phenomenon (process) whose reason (cause) in its basis (root) is not a dynamic process (a process of shifting matter from one place to another), and which is not an expression of the essence of the process of interaction. The reason for this assertion is the fact that without motion of matter, i.e. without dynamics (without mechanics), there are no changes of matter of the objects – there is no interaction and there are no natural changes of the properties of the objects, i.e. without dynamics (mechanics) nature should be absolutely fixed – in a static state.

In this sense, the notion of dynamics (mechanics) is an expression of the essence of the process of interaction between the objects and is only possible on condition that matter is homogenous in its essence, as it was treated by Isaac Newton in his times and thus the foundations of natural sciences were effectively laid. The reason for this assertion is also the fact that the notions quantity of matter, respectively mass, were described by identical properties in his books: "Mathematical Principles of Natural Philosophy" of 1687 and "Opticks..." of 1704.

From the circumstances (the facts) that:

a) *For all interactions between various objects Newton used only one kind of quantity of matter via its abstracted notion of mass for the matters of the various kinds of objects.*

b) While studying the gravitational property and the gravitational forces between various objects, (including planets), although spectral analysis was not known in those times and no evidence was available, he assumed (postulated) that the other space objects consisted of the same chemical elements. *Then, as well as today, the experimental facts confirm that all masses are really of homogenous essence, since they generate homogenous in its essence gravitational fields and forces.*

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* As Nobel Laureate Prof. L. Pauling put it, "Chemistry is electrodynamics at atomic and molecular levels."

c) Therefore, this inference follows:

Isaac Newton *developed modern mechanics (dynamics) dealing solely and only with homogenous in its essence matter, which is known by the abstracted notion of mass and which is placed in the center of gravity of the studied objects.* **However, in the section of electromagnetic theory, (which involves dynamics as well, called electrodynamics), alongside with the notion of electromagnetic or electric matter, the notion of mass is also used. Moreover, the mass of the electromagnetic (electric) matter manifests the same properties as the mass in Newton, and it also manifests inertial and gravitational properties.** For instance, the abstracted notion of quantity of electromagnetic matter of the electron, which is an independent electric charge (mass of the electron) is at the same time carrier of electromagnetic (electric and magnetic), gravitational and inertial properties.

In the sense set forth herein, both in Newton's times and now, physics deals with the idea that matter is homogenous (unitary), and it is agreed that Maxwell's theory is not complete without gravitation; for this reason, the Principal (1.2-5) involves Newton's theory of gravitation and only then is the electromagnetic theory of electromagnetic matter complete. The motivation for this is the well-known experimental fact that electromagnetic waves (electromagnetic matter) generate gravitational field and for this reason they are attracted by the gravitation of the Sun. In fact, the laws of Newton's mechanics at $m = $ const. and low velocities $v \ll c$ are derived as specific cases of the theory of electromagnetic matter at mass $m \neq$ const. and $v < c$.

I.e. the only cause of the alteration of the state and the properties of objects, according to Newton's electrodynamics, is the alteration of the energy (mass) as a result of the action of a force, which is essentially released or absorbed energy (mass).

These facts make it apparent that the phenomenon of interaction involves release (emission) of matter (mass and energy) from one object and its absorption (assimilation) by another object. That assimilation (absorption) of the matter released from the other object by the matter of the absorbing object is only possible on condition that the energies and matters (masses) of the objects are of homogenous essence (of identical nature).

The fact that Newton believed that the objects interacting by force $\vec{F}$ are homogenous, is essentially also confirmed by the circumstance that all quantities, which he used to describe the laws were called by him only mechanical. **Newton associated the notion of motion (shift) with the notion of mechanical, i.e. the notion of mechanical is synonymous to the notion of motion. Or all quantities and processes, which participate in a force interaction, were called by him mechanical since they are characterized by motion, i.e. motion defines the essence of the quantities and processes, which he called mechanical.** Even at present (nowadays), motion is viewed as a mechanical process, regardless of the essence of the cause (kind of the force), while the inherent essence of the objects which move is not discussed (regardless of the essence of the matter of the objects which move).

On p. 748, Khaikin[*] wrote: "This means that the traditional division of the problems of body motion into "Mechanics" and "Non-mechanics", based on a totally obsolete division of forces into "mechanics" and "non-mechanics", has lost any meaning from the viewpoint of modern physical ideas."

In the above aspect, Newtonian electrodynamics maintains the principle of the mechanical essence of the process of motion of all objects. I.e. in the sense that every motion of objects is a mechanical process of a homogenous essence of its substance, and which in the aspect of mechanical motion have characteristics of motion (shift of homogenous matter from one place to another), since they are participants in mechanical motion.

*In this sense, the motion of the electron, which is a substantial form of electromagnetic matter (a quantity of electromagnetic essence) is a mechanical process, from the viewpoint of classical and modern mechanics. **I.E. AT PRESENT, THE NOTION OF MECHANICS OR THE ADJECTIVE 'MECHANICAL' (MECHANIC) IMPLIES A SECTION (FIELD) OF PHYSICS, WHICH DESCRIBES (STUDIES) THE PHENOMENON MOTION OF QUANTITY OF MATTER (MASS) FROM ONE OBJECT TO ANOTHER, WITHOUT TREATING THE ESSENCE OF MATTER OF THE MOVING OBJECTS NOR THE QUANTITATIVE OR STRUCTURAL CHANGES OF THE OBJECTS. I.e. THE INITIAL FORMULATION IS THAT THE PROCESS OF FORCE INTERACTION WAS CALLED A MECHANICAL PROCESS BY NEWTON.***

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[*] S. E. Khaikin. Fizicheskie osnovi mekaniki (Physical Grounds of Mechanics). Publ. "Nauka". Moscow, 1971.

University physics, in its section of mechanics, discusses relativistic mechanics as well, which is mechanics at velocities of motion close to the velocity of light; relativistic mechanics (Newtonian electrodynamics) is at velocities:

$$\text{a) } v \leq c \text{ ; b) } \frac{v}{c} \to 1 \text{ ; c) } 0 \ll v \leq c \text{ ;} \qquad (2.2\text{-}1)$$

Classical mechanics discusses electrodynamic processes at velocities

$$\text{a) } v \ll c \text{ ; b) } \frac{v}{c} \to 0 \text{ ; c) } 0 < v \ll c \text{ ;} \qquad (2.2\text{-}2)$$

Moreover, it is well known that from the laws of Newtonian electrodynamics, with assuming the condition (2.2-2), which holds true for the velocity in classical mechanics, the laws of classical mechanics can be derived, with the only difference that with Newtonian electrodynamics it is assumed that objects are of electromagnetic matter, and this fact implies that the laws of Newtonian electrodynamics are electromagnetic laws, and their processes of interaction – electromagnetic processes. Furthermore, when electromagnetic processes occur at velocities as in (2.2-2), they can also be described by the laws in (2.2-1) about which it is assumed that they are also Newton's laws, but out of them, under condition (2.2-2) are reduced the laws of classical mechanics.

Or the magnetic (kinetic) energy of an object with mass m_0 at rest, at velocity $v \ll c$ (2.2-2) is described by Newtonian electrodynamics at velocity $v < c$ (2.2-1) and by classical mechanics at (2.3-2)

$$W_H = W_K = m_0 . c^2 \left[\left(1 - \beta^2\right)^{-\frac{1}{2}} - 1 \right] = \frac{m_0 . v^2}{2}; \beta = \frac{v}{c}; ; \qquad (2.2\text{-}3)$$

but the simpler expression $\frac{m_0 . v^2}{2}$. is preferred.

In this sense, the broadest laws of motion are described by the laws of Newtonian electrodynamics, while the laws of classical mechanics, without any doubt or contradiction, are a specific case of relativistic laws under condition (2.2-3).

These circumstances are known to researchers, who handle only classical mechanics, but nonetheless, most of them, due to their conservatism, do not accept the fact that classical mechanics is a specific case of relativistic mechanics (of Newtonian electrodynamics). Or rather, they do not like (enjoy) this fact. This lack of enjoyment may be justified to a certain extent, since relativistic mechanics (electrodynamics), which was created about 200 years after classical mechanics, uses the methodology of classical mechanics, and this fact seems to be ignored in the above presentation, particularly in the text – specific case.

THEREFORE, A SUMMARIZED ANALYSIS OF THE PRESENT STATE OF NEWTONIAN ELECTRODYNAMICS MAKES IT CLEAR THAT IT IS THE BROADEST MECHANICAL THEORY, WHICH INVOLVES BOTH RELATIVISTIC AND CLASSICAL MECHANICS IN ONE WHOLE.

2.3. INFERENCES

1. Newtonian electrodynamics (relativistic electrodynamics), which holds true for all velocities, from zero to the velocity of electromagnetic waves, is the initial theoretical basis of the laws of motion of material objects.

2. Classical mechanics is a specific case of Newtonian electrodynamics at velocities much lower than the velocity of electromagnetic waves, therefore, its laws are approximate (simplified), but sufficiently precise for practice to describe mechanical processes at low velocities.

3. The laws of mechanics hold true only on condition that the essence of matter of the objects, whose motion they describe, as well as their energies and masses (matters) are only of homogenous and electromagnetic matter.

4. Newtonian electrodynamics at the present stage can be considered as appropriate to the ideal of science or it could be regarded as the ideal of a science, which explains (describes) natural diversity in the form of a system of homogenous in their essence models of abstracted notions. This system is hierarchical and comprises genetically homogenous knowledge, which has one initial, genetically homogenous deductive principle (theoretical basis, such as the Principal (see Chapter I, paragraph 3).

CHAPTER THREE
SUBSTANCE (ATOMS AND MOLECULES)
IS A STRUCTURE OF ELECTROMAGNETIC MATTER

3.1. GENERAL SOLUTIONS

The process of interaction between objects is accompanied by a process of their being restructured. As a result of these processes, the objects obtain new properties, different from these before the interaction.

To make a full and precise analysis and give an answer to the question of what substance is, it is proceeded from the formulae through a mathematical description of several typical processes of interaction, which also have been experimentally confirmed for restructuring of matter of given objects from one state into another (from given elementary particles into others).

First Example

During interaction between electron e_0^- and positron e_0^+ at rest ($v = 0$) they become restructured into photons (momentums of electromagnetic waves) γ, which move at the velocity c of light (of electromagnetic waves).

And when a gamma photon γ_Γ collides into the atom nucleus, the photon is restructured into electron e_0^- and positron e_0^+

$$\text{a) } e_0^- + e_0^+ \to 2.\gamma \text{ ; b) } \gamma_\Gamma \to e_0^- + e_0^+ \text{ ;} \tag{3.1-1}$$

Or, if these reactions between the elementary particles electrons and photons are described through their energies, taking into account that the energies W_0 and the masses m_0 of the particles and the antiparticles (for example, the electron and the positron are a particle and its antiparticle) at rest have identical values, it follows from (3.1-1) that:

$$\text{a) } W_{e0^-} + W_{e0^+} = 2.W_{e0} = m_{eo^-}.c^2 + m_{e0^+}.c^2 = 2.m_{e0}.c^2 = 2.W_f = 2.h.v \text{ ;}$$

$$\text{b) } v = \frac{m_{e0}.c^2}{h} \to \lambda = \lambda_k = \frac{c}{v} = \frac{h.c}{m_{e0}.c^2} = \frac{h}{m_{e0}.c} \text{ ; c) } W_\Gamma = h.v_\Gamma = 2.m_{e0}.c^2 \text{ ;} \tag{3.1-2}$$

where: W_{e0^-} and W_{e0^+} are the energies at rest (the internal energies) of the electron and positron; m_{eo^-} and m_{e0^+} - the masses of the electron and positron at rest; W_f – energy of photon; h – Planck's constant; v – frequency of the photon; $v_{\Gamma\_}$ frequency of the gamma photon, since photons in this reaction (3.1-1)b have a frequency of a gamma photon; c – velocity of light in vacuum (velocity of the electromagnetic waves in vacuum); λ_k – Compton wave length.

Second example:

It is a well-know experimental fact that during interaction between accelerated electron e^- and positron e^+, depending on the conditions, their kinetic (magnetic) energies are restructured into protons (proton p and antiproton $\bar{p}$) or into neutrons (neutron n and antineutron $\bar{n}$) as follows:

$$\text{a) } e^- + e^+ \to e_0^- + e_0^+ \to (p + \bar{p}) \text{ ; b) } e^- + e^+ \to e_0^- + e_0^+ \to (n + \bar{n}) \text{ ;} \tag{3.1-3}$$

Here it should be noted that:

1) The mass of the electron at rest m_{eo} is equal to the mass of energy W_{e0} of its electrostatic field.

$$\text{a) } W_{e0} = q_e^2.k_E \text{ ; b) } k_E = \left(4\pi\varepsilon_0.r_{e0}\right)^{-1} \text{ ; c) } m_{e_0} = \frac{W_{e0}}{c^2} = q_e^2.k_m \text{ ; d) } k_m = k_E.c^{-2} \text{ ;} \tag{3.1-4}$$

where: ε_0 is the dielectric constant of vacuum; r_{e0} – the computational (the classical) radius of the electron.

2) The full (total) electromagnetic energy W_t of the electron at velocity $v < c$ is

$$\text{a) } W_t = W_{e0} + W_H = m_e c^2 = m_{e0}.\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}}.c^2 = m_{e0}.\left(1 - \beta^2\right)^{-\frac{1}{2}}.c^2 \text{ ; b) } \beta = \frac{v}{c} \text{ ;} \tag{3.1-5}$$

where: m_e is the mass depending on velocity

$$m_e = m_{e0}\left(1-\beta^2\right)^{-\frac{1}{2}};$$
(3.1-6)

and the magnetic (kinetic) energy of the electron W_{He} is:

$$W_{He} = W_t - W_{e0} = m_{e0}.c^2.\left[\left(1-\beta^2\right)^{-\frac{1}{2}}-1\right] = q_e^2.k_m.c^2.\left[\left(1-\beta^2\right)^{-\frac{1}{2}}-1\right];$$
(3.1-7)

Then, under these conditions, the notation of (3.1-3) through the energies is:

a) $2W_{eo} + W_{ke^-} + W_{ke^+} = 2.W_{e0} + 2.m_p.c^2$; b) $2.W_{He} = W_{He^-} + W_{He^+}$
(3.1-8)

or it follows from (3.1-8) that:

a) $2.W_{e0} + 2.W_{He} = 2W_{e0} + 2.m_{p0}.c^2$; b) $2.W_{He} = 2.m_{p0}.c^2$;
(3.1-9)

and it follows from (3.1-9) and (3.1-7) that:

$$m_{p0} = m_{\bar{p}0} = q_e^2.k_m.\left[\left(1-\beta_p^2\right)^{-\frac{1}{2}}-1\right] = m_{e0}.\left[\left(1-\beta^2\right)^{-\frac{1}{2}}-1\right];$$
(3.1-10)

With an analogous procedure for (3.1-3b) it follows that:

$$m_{n0} = m_{\bar{n}0} = q_e^2.k_m.\left[\left(1-\beta_n^2\right)^{-\frac{1}{2}}-1\right] = m_{e0}.\left[\left(1-\beta^2\right)^{-\frac{1}{2}}-1\right];$$
(3.1-11)

where: $\beta_p = \dfrac{v_p}{c}$ and $\beta_n = \dfrac{v_n}{c}$, v_p and v_n are the velocities of the electrons in reactions (3.1-3a) and (3.1-3b), since protons and neutrons have various masses $m_p \neq m_n$. Moreover, the internal energies (the energies at rest) of the proton and the neutron are:

a) $W_{p0} = m_{p0}.c^2$; b) $W_{n0} = m_{n0}.c^2$;
(3.1-12)

and they are equal to the relevant kinetic energies of the electron or the positron, i.e.

a) $W_{He} = W_{p0} = m_{p0}.c^2$; b) $W_{He} = W_{n0} = m_{n0}.c^2$;
(3.1-13)

And vice versa – the masses at rest of the proton and neutron are equal to the masses of the magnetic energies of the electron or positron:

a) $m_{p0} = \dfrac{W_{He}}{c^2}$; b) $m_{n0} = \dfrac{W_{He}}{c^2}$;
(3.1-14)

The regularities described above are experimentally confirmed, which fact implies that these regularities are axiomatic truths – axioms. Because of this circumstance, it ought to be made clear that the analysis and the conclusions drawn from the axioms are logically well grounded, i.e. they are reliable.

Under these conditions, when replacing the expression for the magnetic (kinetic) energy of the electrons in (3.1-10) and (3.1-11) with W_{He} from (3.1-7), we have these formulae for the masses m_p and m_n:

$$m_{p0} = \frac{W_{He}}{c^2} = m_{e0}.\left[\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}-1\right] = q_e^2.\left[\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}-1\right].k_m = Q_p^2.k_m;$$
(3.1-15)

$$m_{n0} = \frac{W_{He}}{c^2} = m_{e0}.\left[\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}-1\right] = q_e^2.\left[\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}-1\right].k_m = Q_n^2.k_m;$$
(3.1-16)

It is apparent from (3.1-7), (3.1-9), (3.1-10) and (3.1-11) that the kinetic (magnetic) energies of electrons (electron and positron) have been restructured (transformed) into masses of proton and neutron. This is the theoretical ground of the well-known experimental facts, described by (3.1-3) a and (3.1-3) b.

Here are used the notions introduced in Chapter one, paragraph 5 of *integral or effective electric charges* of proton Q_p^2 and neutron Q_n^2.

$$a)\ Q_p^2 = q_e^2.\left[\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}-1\right];\ b)\ Q_n^2 = q_e^2.\left[\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}-1\right];$$
(3.1-17)

Under these conditions, the mass m_T and the total energy of a body with mass m_T are:

a) $m_T = Q_T^2.k_m$; b) $W_T = m_T.c^2 = Q_T^2.k_m.\left(1 - \dfrac{v^2}{c^2}\right)^{-\frac{1}{2}}.c^2$; (3.1-18)

The energy of the body at rest is:

$$W_0 = m_T.c^2 = Q_T^2.k_m.c^2 ;$$ (3.1-19)

The magnetic (kinetic) energy of the body is:

$$W_H = W_k = W_T - W_0 = Q_T^2.k_m.c^2.\left[\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}} - 1\right];$$ (3.1-20)

which is in full compliance with the values for electrons.

Emphasis

Magnetic energy and mass of an electron are essentially kinetic energy and mass of the electron. **This was defined in "Treatise on electricity and magnetism" by J. K. Maxwell of 1873 in paragraph 638, where he wrote: "we should consider both magnetic and electromagnetic energies as kinetic energies".**

The results obtained above coincide with these in the special theory of relativity, but here they are proved only on the basis of Maxwell's classical electrodynamics of 1873 and by using only Galileo's transformations as described by Isaac Newton in 1687. And since they are obtained using fewer initial formulations (without the postulate of constancy of the velocity of light and without Lorentz transformations) according to the principle of simplicity (Occam's razor) they are more perfect, and along with this they represent a more reliable approach. **And since they explain the gain of mass of the electron by accretion of the mass of its magnetic energy, they give a more profound analysis, i.e. this solution should be preferred as a general and initial one compared to the solution given by the special theory of relativity, because it** *simplifies the physical laws and clarifies the physical meaning of the gain of mass.*

3.2. INFERENCES

First

Masses and internal energies of protons and neutrons (3.1-10), (3.1-11) and (3.1-12) are proportional to the squares (q_e^2) of the electric charges of the electron and positron, respectively of the mass of the electrons (m_{eo}), i.e. protons and neutrons are matter of electromagnetic essence – electromagnetic elementary particles. Or protons and neutrons are electromagnetic matter.

Second

Kinetic energies of the proton and neutron are solely electromagnetic in the form of a magnetic structure.

Conclusion to the second inference

All bodies of mass m_T, including the neutron, which is externally electrically neutral, when moving at velocity v < c and v << c generate magnetic energy (magnetic fields) with a value (3.2-20)

$$W_{He} = W_{ke} = m_{TO}.c^2.\left[\left(1 - \beta^2\right)^{-\frac{1}{2}} - 1\right];$$ (3.2-21)

This equation at $v<<c \rightarrow \dfrac{v}{c} \rightarrow 0$, after expanding $\left(1 - \beta^2\right)^{-\frac{1}{2}}$ in power series and taking only the first two terms of the series is reduced to

$$W_H = W_k = m_{TO}.c^2.\frac{1}{2}.\frac{v^2}{c^2} = \frac{m_{T0}.v^2}{2} ;$$ (3.2-22)

Here m_{T0} is the mass of the object (body) at rest (v=0).

This is an experimentally proved and undeniable scientific fact.

Third

Apparently, when the electron moves at velocity $v \neq 0$, which is obtained as a result of the additional energy ΔW imparted to it through the action of force $\vec{F}$ (which draws energy $\Delta W = \vec{F}.\Delta \vec{r}$ from an external source (external field $\vec{E}$, $\vec{H}$ or $\vec{G}$)), this energy ΔW is transformed in the electron by means of its electrostatic field $\vec{E}$ into its own magnetic energy $\Delta W_H = \Delta W$ which has mass $\Delta m = \dfrac{\Delta W_H}{c^2}$

(since it is evident from the law $W = m.c^2$ that each energy W has mass $m = \dfrac{W}{c^2}$)

This magnetic energy is function of the square of velocity of the electron v^2. And the velocity is altered, depending on the sign of alteration of the velocity $\pm \Delta v$, ΔW_H and Δm also alter by getting increased or decreased. Here Faraday's law of induction $\left(\dfrac{d\Phi_H}{dt} = -E \right)$ manifests implicitly.

In this sense, the mass of alteration of an electron at velocity $v \neq 0$ is always different from zero, since there is always a gain of magnetic energy $\Delta W_H \neq 0$ and mass $\Delta m_H \neq 0$. **This fact means that strictly speaking, the mass of bodies, which are in motion ($v \neq 0$) is not constant, but is always greater than their mass at rest. But this additional mass Δm at velocity $v \ll c$ is much smaller than their mass at rest $m_{e0} - \Delta m \ll m_{e0}$ and therefore it is usually ignored.**

Fourth

The mass of the electron m_{c0} at rest ($v=0$) and the mass m_H of magnetic energy W_H bound to it (at velocity $v \neq 0$) always generate gravitational fields:

$$\text{a) } \vec{G}_0 = -\frac{m_{e0}.\gamma.\vec{r}_0}{r^2} \text{ ; b) } \vec{G}_{\Delta H} = -\frac{m_H.\gamma.\vec{r}_0}{r^2} \text{ ;} \tag{3.2-23}$$

where: γ is the gravitational constant
to which correspond the densities of their gravitational energies:

$$\text{a) } w_{G0} = \frac{G_0^2}{2.\gamma} \text{ ; b) } w_{GH} = \frac{G_{\Delta H}^2}{2.\gamma} \text{ ;} \tag{3.2-24}$$

and respective gravitational energies after integrating (3.2-24)

$$\text{a) } W_{G0} = \int w_{G0}.dV \text{ ; b) } W_{GH} = \int w_{CH}.dV \text{ ;} \tag{3.2-25}$$

and their respective gravitational masses:

$$\text{a) } m_{G0} = \frac{W_{G0}}{c^2} \text{ ; b) } m_{GH} = \frac{W_{GH}}{c^2} \text{ ;} \tag{3.2-26}$$

which give an insignificant contribution to the full mass of the electron (of the body) and for this reason are ignored. **IT SHOULD BE NOTED THAT THERE ARE NO INDEPENDENT GRAVITATIONAL FIELDS, NOR INDEPENDENT GRAVITATIONAL ENERGIES, WHICH ARE NOT DIRECTLY BOUND TO THE ELECTROMAGNETIC MATTER WHICH GENERATES THEM. FOR THE SAME REASON, THERE ARE NO INDEPENDENT GRAVITATIONAL WAVES.**

Fifth

It is evident from the reactions (3.1-1 a) or (3.1-2 a), which describe the process of interaction between electron e_0^- and positron e_0^+ in a state of rest ($v = 0$), that as a result of this process of interaction, they are restructured into the elementary particles photons with energies W_f, masses m_f and momentums $\vec{P}_f$, which move at velocity c, and which are:

$$\text{a) } W_f = h.\nu \text{ ; b) } m_f = \frac{W_f}{c^2} \text{ ; c) } \vec{P}_f = m_f.\vec{c} = \frac{W_f}{c}.\vec{c}_0 \text{; d) } \vec{G}_f = -\frac{m_f.\gamma.\vec{r}_0}{c^2} \text{; e) } \vec{c}_0 = \frac{\vec{c}}{|\vec{c}|} \text{ ;} \tag{3.2-27}$$

It is apparent from these experimentally confirmed reactions of interaction that in the electron and positron at rest there exists (there is a potential of) in an implicit form their potential property of self-motion (or of motion). And this potential property of self-motion in the conditions (the situation) of the electron and positron one next to the other in a state of rest ($v = 0$) is generated in explicit (real) motion. This results in their restructuring into photons, which are self-moving at the velocity of electromagnetic waves c.

It is only at motion of the structural elements of the initial elementary particles (the electron and positron) that they are restructured into new elementary particles (photons), which move at the velocity of the electromagnetic waves c. This is the mechanism of restructuring as a result of the interaction, which essentially is also a mechanism of performing work during the interaction between two objects. In physics, this process is described by the action of force F, which by definition has dimensionality:

$$\text{a) } F \rightarrow \left[\text{J.m}^{-1} \right] = \frac{\text{Joule}}{\text{distance}} = \frac{\text{energy}}{\text{distance}}; \text{ b) } F = \frac{W}{r}; \tag{3.2-28}$$

I.e. **by definition, during interaction between two objects, force F is carrier of the mass and energy, which one object conveys to (exchanges with) the other object along a unit of pathway during the interaction.**

Since the energies W and the masses m are connected $\left(W = m.c^2 \right)$, then to force F correspond energy W_F and mass m_F, exchanged along of a unit of pathway, ($r = 1$)

$$\text{a) } W_F = F; \text{ b) } m_F = \frac{W_F}{c^2} = \frac{F}{c^2}; \tag{3.2-29}$$

These energy W_F and mass m_F are in the form of respective elementary particles of matter, which in the electrons are photons, and they carry the electromagnetic matter (energy) and the momentum from one object to another at the velocity of the electromagnetic waves (light) c.

IT IS EXACTLY THE MECHANISM DESCRIBED ABOVE THAT PROVES THAT ELECTROMAGNETIC MATTER HAS THE POTENTIAL PROPERTY OF SELF-MOTION, WHICH DETERMINES ITS ABILITY TO BE RESTRUCTURED OR TO PERFORM WORK.

And the notion of force illustrates the conveyance of a certain quantity (quantum) of matter in the process of interaction. This changes the quantities of matters of the interacting objects. **Only when the alteration of the quantities of their matters (masses) and their energies exceeds or is equal to their measure of new properties of the object, only then is there restructuring, which leads to new properties of the objects.**

3.3. THE ATOM IS AN ELECTROMAGNETIC STRUCTURE, I.E. THE ATOM IS A STRUCTURE OF ELECTROMAGNETIC MATTER

Since in a general case, the atom is a structure of N electrons, P protons and K neutrons, it follows, in accordance with the presented above, that the mass of the atom is

$$m_{AT} = N.m_e + P.m_p + K.m_n = N.q_e^2.k_m + P.Q_p^2.k_m + K.Q_n^2.k_m =$$
$$= \left(N.q_e^2 + P.Q_p^2 + K.Q_m^2 \right).k_m = Q_{AT}^2.k_m; \tag{3.3-30}$$

where the square of the effective electric charge of the atom is

$$Q_{AT}^2 = N.q_e^2 + P.Q_p^2 + K.Q_n^2; \tag{3.3-31}$$

And N, P and K are numbers, determining the values of the respective charges.

The mass of the atom is as the mass of an object (body)

$$m_{AT} = Q_{AT}^2.k_m; \tag{3.3-32}$$

and if the value of the mass of the respective atom m_{AT1} is known, its square of effective electric charge is

$$Q_{AT1}^2 = \frac{m_{AT1}}{k_m}; \tag{3.3-33}$$

I.e. from the known masses of the atoms of the chemical elements we can determine their squares of effective electric charges. This fact implies that it is possible to determine the squares of effective electric charges of all atoms. This condition means that we can handle the masses of atoms m_{AT} in the same was as the masses of electrons.

It should be noted that the masses of the molecules are not the arithmetic sum of the number of their atom masses, since when they bound into molecules, the defects of their masses drop off.

Therefore, for each molecule, the specific value of its mass should be taken into consideration and out of it be determined its respective square of effective electric charge.

For the quantity of mass of substance (electromagnetic matter), it is possible out of its weight to determine the square of its effective electric charge and then handle it in the same way as a mass of electron, i.e.

$$\text{a) } m_B = m_T = Q_T^2 . k_m; \text{ b) } Q_T^2 = \frac{m_T}{k_m};\qquad(3.3\text{-}34)$$

The presented above cogently shows that the masses of real objects in nature can be handled in the same way as masses of structures of electric charges, i.e. as masses of electrons.

In this sense, the masses, which are used in classical mechanics are also masses of electromagnetic matter, and therefore, classical mechanics should be treated as classical electrodynamics.

3.4. CONCLUSION

Masses of real natural objects, provided that their specific values are known, can be handled in the same way as masses of electrons, and essentially, their kinetic energies are magnetic energies. That explains why, at accelerations different from zero $a \neq 0$ bodies always emit electromagnetic energy – electromagnetic waves, as well as electrons with power

$$\frac{dW}{dt} = N = \frac{2.a^2.Q_T^2}{3.c^3};\qquad(3.3\text{-}35)$$

This fact accounts for emission of electromagnetic waves in collisions between substantial objects, where their velocity decreases from $v > 0$ to zero $v = 0$ in time τ, i.e. it decreases by mean acceleration

$$\bar{a} = \frac{v}{\tau};\qquad(3.3\text{-}36)$$

In addition, the structural bonds between atoms and molecules break and electrons alter their orbits, during which processes there is photon emission.

CHAPTER FOUR
THE INERTIAL FORCE IS AN ELECTROMAGNETIC FORCE

Since the inertial force is a manifestation of electromagnetic matter, whose lowest or initial level are the electromagnetic elementary particles of electrons (electron and positron), for a better cogency of the idea of the electromagnetic mechanism of the inertial force, we shall first consider the electrons, which are accepted as a model of electromagnetic matter, and which ensure the electromagnetic essence of the inertial property of electromagnetic matter.

4.1. MANIFESTATIONS (PROPERTIES) OF ELECTRONS

4.1.1. Electrostatic: field, energy and mass of the electron

At distance $\vec{r}$ from an electron at rest there is electrostatic field

$$\vec{E} = \frac{q_e.\vec{r}_0}{4\pi\varepsilon_0 r^2} ; \ \vec{r}_0 = \frac{\vec{r}}{|\vec{r}|} ;\qquad(4.1\text{-}1)$$

where: ε_0 is the dielectric constant of vacuum.

The electrostatic field has densities of its energy and mass

$$\text{a) } w_E = \frac{\varepsilon_0 E^2}{2}\text{ ; b) } \rho_E = \frac{w_E}{c^2}\text{ ,}$$

(4.1-2)

and electrostatic energy W_{eE0} and its mass m_{e0}, the mass of electron at rest, are:

$$\text{a) } W_{eE0} = \int_{r_{e0}}^{\infty} w_e.dV = \frac{q_e^2}{4.\pi.\varepsilon_0.r_{e0}}\text{ ; b) } m_{e0} = \frac{q_e^2}{4.\pi.\varepsilon_0.r_{e0}.c^2} = q_e^2.k_m\text{ ;}$$

(4.1-3)

$$\text{c) } k_m = \left(4.\pi.\varepsilon_0.r_{e0}.c^2\right)^{-1}\text{ ;}$$

where: r_{e0} is the computational (classical) radius of electron; V – volume.

4.1.2. Magnetic field and magnetic (kinetic) energy and mass

At velocity $v < c$, around the electron at distance r in point M and around it, magnetic field is generated

$$\text{a) } \vec{H} = \varepsilon_0.\left[\vec{v}.\vec{E}\right] = \frac{q_e.v}{4.\pi.r^2}.\left[\vec{v}_0.\vec{r}_0\right]\text{ ; b) } \vec{v}_0 = \frac{\vec{v}}{|\vec{v}|}\text{ ;}$$

(4.1-4)

with densities of the magnetic energy w_H and mass ρ_H of the electron

$$\text{a) } w_H = \mu_0.\frac{H^2}{2}\text{ ; b) } \rho_H = \frac{w_H}{c^2}\text{ ; } \mu_0 = \frac{1}{\varepsilon_0.c^2}\text{ ;}$$

(4.1-5)

In point M at distance r, besides the generated w_H and ρ_H, there are the constant and independent of time $w_E = \text{const.}$ and $\rho_E = \text{const.}$ (4.1-2), since they only depend on the charge $q_e = \text{const.}$

Therefore, the resultant density of mass in point M is:

$$\text{a) } \rho_M = \rho_E + \rho_H\text{ ; } \to \text{b) } d\rho_M = 0 + d\rho_H = d\rho_H\text{ ;}$$

(4.1-6)

where the density of the mass of the magnetic field ρ_H is function of the velocity v of the electron.

The generation of magnetic field, or of magnetic energy of electron respectively, results from (is at the expense of) the energies imparted by the forces of interaction of external electric $\vec{E}_B$ or gravitational $\vec{G}_B$ fields, as a result of which it is set into motion at velocity $\vec{v}$, by force

$$\text{a) } \vec{F}_e = q_e.\vec{E}_B = \frac{d\vec{P}_e}{dt} = \frac{d\left(m_e.\vec{v}\right)}{dt}\text{ ; b) } \vec{F}_G = m_e.\vec{G}_B\text{ ;}$$

(4.1-7)

whereby acceleration $\vec{a}_e$, velocity $\vec{v}_e$ and momentum $\vec{P}_e$ are imparted to the electron

$$\text{a) } \vec{a}_e = \vec{a}_d = \frac{\vec{F}}{m_e}\text{ ; b) } \vec{v} = \vec{a}_e.t = \vec{a}_d.t = \frac{\vec{F}}{m_e}.t\text{ ; c) } \vec{P}_e = m_e.\vec{v}_e\text{ ;}$$

(4.1-8)

Here the following circumstances should be emphasized:

First. *Since the dimensionality of the force is $\vec{F} \to [Joule/meter] = [J.m^{-1}]$, the energy imparted by external fields E_B and G_B to the electron, is transformed into energy of a magnetic field, respectively magnetic energy of the electron.*

Second. *The mass of the electron m_e is the gravitational charge for gravitational field G , by analogy from (4.1-7), like q_e, which is electric charge for E_B.*

Third. *When external fields $\vec{E}$ and $\vec{G}$ interact with the charge of the electron q_e and its mass m_e , forces $\vec{F}_e$ and $\vec{F}_G$ are generated, which impart to the electron energy, or respectively, acceleration, velocity and momentum for time dt , or they move it along distance $d\vec{r} = \vec{v}.dt$, respectively. The energy dW and mass dm imparted by the external fields in this process of movement, through the forces, are:*

a) $dW_e = \vec{F}_e.d\vec{r} = \vec{F}_G.d\vec{r} = \dfrac{d\vec{P}_e}{dt}.d\vec{r} = \vec{v}.d\vec{P} = \vec{v}.d\left(m_e.\vec{v}\right)$; b) $dm_e = \dfrac{dW_e}{c^2}$; (4.1-9)

Since W. Kaufmann experimentally proved in 1901 that mass m_e of the electron is a variable function of velocity, this experimental result should be reflected in the derivative of $\vec{P}_e$, respectively through the force

$$\vec{F} = \frac{d\vec{P}_e}{dt} = m_e.\frac{d\vec{v}}{dt} + \vec{v}.\frac{dm_e}{dt};$$ (4.1-10)

And according to Chapter 1, paragraph 5, the magnetic energy and mass of the electron at velocities

$$\text{a) } v < c; \text{ b) } \beta = \frac{v}{c} < 1;$$ (4.1-11)

are

$$\text{a) } W_{He} = m_{e0}.c^2\left[\left(1-\beta^2\right)^{-\frac{1}{2}} - 1\right]; \text{ b) } m_{He} = \frac{W_{He}}{c^2};$$ (4.1-12)

These formulae for W_{He} and m_{He} hold true for all velocities of the electron v, lower than c ($v < c$).

These formulae, however, are very complex for the cases when the velocity of the electron v is much lower than the velocity of electromagnetic waves c, i.e. at

$$\text{a) } v \ll c ; \rightarrow \text{b) } \frac{v}{c} \ll 1 \text{ or c) } \frac{v}{c} \rightarrow 0;$$ (4.1-13)

Here the function $\left(1-\beta^2\right)^{-\frac{1}{2}}$ is expanded in a power series

$$\left(1-\beta^2\right)^{-\frac{1}{2}} = 1 + \frac{1}{2}\beta^2 - \frac{3}{8}\beta^4 + \frac{15}{18}\beta^6 ... ;$$ (4.1-14)

and with sufficient preciseness at $v \ll c$, magnetic energy W_{He} of the electron is derived by taking only the first two terms of the series (4.1-14), and we have

$$W_{He} = W_{e0}\left[1 + \frac{1}{2}\beta^2 - 1\right] = W_{e0}.\frac{1}{2}.\frac{v^2}{c^2} = m_{e0}.c^2\frac{1}{2}.\frac{v^2}{c^2} = \frac{m_{e0}.v^2}{2} = W_{ke};$$ (4.1-15)

This expression of magnetic energy of the electron at $v \ll c$ is called kinetic energy in mechanics. This mass of the magnetic energy also corresponds to it

$$\text{a) } m_{He} = \frac{W_{He}}{c^2} = \frac{m_{e0}.v^2}{2.c^2} \ll m_{e0} \text{ ; b) } \frac{v^2}{c^2} \rightarrow 0; ;$$ (4.1-16)

Due to which it is accepted that the sum of the mass of the electron m_{e0} (4.1-13) and m_{He} (4.1-12) is

$$m_e = m_{e0} + m_{He} \approx m_{e0} = q_e^2.k_m = \text{const.};$$ (4.1-17)

i. e. because $m_{He} \ll m_{e0}$, m_{He} is dropped off and calculations are done only at m_{e0}.

However, formulae (4.1-15) and (4.2-16) for W_{He} and m_{He} hold also true at $v \ll c$ for magnetic energy and masses, although $W_{He} = W_k$ is called kinetic energy in classical mechanics, and m_{He} is never considered, because in I. Newton's times, the notion of field was unknown nor was the relationship between the internal energy and mass ($W = m.c^2$).

4.2. TRANSFER OF ELECTROMAGNETIC ENERGY FROM ONE OBJECT TO ANOTHER

4.2.1. General formulations

There is a basic experiment in mechanics, in which two identical balls collide. When ball 1 moves at velocity v_1 and collides centrally with ball 2, which is at rest $\left(v_2 = 0\right)$, after the collision ball 1 remains at rest $\left(v_1 = 0\right)$ in the place of collision, and ball 2 starts moving at velocity $v_2 = v_1$.

A similar effect is obtained with two electrons or with one electron and a body or with two bodies, because they are made of electromagnetic matter, whose structural elements (electrons, protons, neutrons) are products of electrons (bipolar independent electric charges), i.e. of electromagnetic elementary particles.

For this purpose, in order to explain the process of transfer of magnetic (kinetic) energy from one object to another, a model is considered of interaction of an electron at velocity $v \ll c$ and another electron at rest $(v = 0)$.

When an electron at velocity $v < c$ and energy W_{He}, given in (4.1-12)a, encounters another electron, which is at rest $(v = 0)$, during an interaction for time dt, the electron reduces its velocity by $d\vec{v} = \vec{a}\,dt$ ($\vec{a}$ is acceleration) along distance $d\vec{r} = \vec{v}\,dt$ and performs work dA, which is equal to the reduction of its energy by dW_{He}, as follows:

$$d A = \vec{F}_e . d\vec{r} = dW_{He} = m_{e0}.c^2.\left(1-\beta^2\right)^{-\frac{3}{2}}.\vec{v}\,d\vec{v}; \; \beta = \frac{v}{c}; \tag{4.2-1}$$

where force $\vec{F}_e$ is:

$$\text{a)} \; \vec{F}_e = \frac{dW_{He}}{dr}.\vec{r}_0 = \vec{v}.\frac{d\vec{P}}{v.dt} = m_{e0}.c^2.\left(1-\beta^2\right)^{-\frac{3}{2}}.\vec{a}; \; \text{b)} \; \vec{a} = \frac{d\vec{v}}{dt}; \; \text{c)} \; \vec{r}_0 = \frac{\vec{r}}{|\vec{r}|}; \tag{4.2-2}$$

In forceful interaction at velocity from $v \neq 0$ to $v = 0$, electron one has mass 1 at rest, which mass m_{e01} has great acceleration and therefore it emits (gives out) electromagnetic energy W_{He} in the form of an electromagnetic wave (a sum of photons) with power $N = \frac{2}{3}.\frac{a^2 q_e^2}{c^3}$ at velocity c and performed work A.

$$A = W_{He} = \int_v^0 dW_{He} = m_{e0}.c^2.\left(1-\beta^2\right)^{-\frac{1}{2}}\Big|_v^0 = m_{e01}.c^2.\left[\left(1-\beta^2\right)^{-\frac{1}{2}}-1\right] = N.t; \tag{4.2-3}$$

This energy is absorbed by electron two which is and it is thus set into motion at velocity v_1 whereby the electron acquires electromagnetic (magnetic, kinetic) energy W_{He} while the energy emitted into the surrounding space in the form of unabsorbed electromagnetic waves is ignored. This magnetic energy at velocity $v \ll c$ is

$$W_{He} = m_{e0}.c^2.\left[\left(1-\frac{v^2}{2.c^2}\right)^{-\frac{1}{2}}-1\right] = \frac{m_{e0}.v^2}{2} = W_k; \tag{4.2-4}$$

For a neutral body with mass m_T, the effective square of the electric charge $Q_T^2 = \frac{m_T}{k_m}$ is used and the body is treated as electron with mass $m_T = Q_T^2.k_m$.

4.2.2. Summaries

4.2.2.1. *Electromagnetic matter is composed (structured) of restructured electric charges with a square of effective value Q_T^2. The fact that according to Maxwell kinetic energy is magnetic energy implies the summarized conclusion that natural objects are made of electromagnetic matter (in a field form and in a substantial form) and that it is a structure of restructured electric charges. These charges are in explicit or implicit, restructured form, i.e. the charges is in independent or summarized (as, for example, in neutrons and other elementary particles) implicit state.*

HOWEVER, REGARDLESS OF WHAT STATE ELECTRIC CHARGES ARE IN, THEY ALWAYS MANIFEST THEIR MAIN (ATTRIBUTIVE) PROPERTY AT MOTION (VELOCITY $v \neq 0$) TO GENERATE (CREATE) A MAGNETIC FIELD ASSOCIATED WITH THEMSELVES - MAGNETIC ENERGY, WHICH IS CALLED KINETIC. And the energy at rest $(v = 0)$ is the energy of their electrostatic and gravitational fields. Almost always their gravitational energies and masses are ignored (not accounted for), since they are **about 10^{40} times smaller than the electrostatic energy and mass.**

4.2.2.2. *ESSENTIALLY, MAGNETIC ENERGY OF ELECTRIC CHARGES IS THE TRANSFORMED ENERGY (ELECTROMAGNETIC OR GRAVITATIONAL), WHICH CHARGES HAVE ABSORBED FROM OUTSIDE IN ORDER TO BE ACCELERATED (FOR THEIR MASS TO BE ACCELERATED) UP TO A RESPECTIVE VELOCITY V* $\left(\vec{v} = \dfrac{\vec{F}_d}{m_e}.t \right)$, *BY THE ACTION OF THE MOTION FORCE* $\vec{F}_d$ *WHICH MAY BE GENERATED BY ELECTROMAGNETIC (* $\vec{E}$ *AND* $\vec{H}$ *) OR GRAVITATIONAL* $\vec{G}$ *FIELDS.*

IN THIS SENSE, THE ENERGY ABSORBED FROM OUTSIDE IS TRANSFORMED INTO MAGNETIC ENERGY. IT IS THAT ENERGY WHICH UNDER CONDITION (4.1-13) $(v \ll c)$ **IS PROPORTIONAL TO THE MASS OF THE CHARGE** m_q **AND THE SQUARE OF ITS VELOCITY, I.E.**

$$W_{qH} = m_T^{'} \frac{v^2}{2};$$ (4.2-5)

And this magnetic energy W_{qH} has mass $m_{qH} = \dfrac{W_{qH}}{c^2}$, which is bound inseparably to the mass of the charge at rest m_{T0}. Because of this, the mass of the body is a sum of its mass at rest and its magnetic mass, $m_{qu} \ll m_{T0}$ and therefore it is ignored, i.e.

$$m_q = m_{T0} + m_{qH} \approx m_{T0};$$ (4.2-6)

Considering Newton's formulation that mass is an abstracted notion of the notion of matter, this conclusion follows:

WHEN A BODY (ITS CHARGE) IS ACCELERATED, ITS QUANTITY OF MATTER INCREASES, SINCE THE MATTER, WHICH IT HAS OBTAINED FROM OUTSIDE – FROM ITS MOTIVE FORCE (ELECTROMAGNETIC OR GRAVITATIONAL) – ADDS TO ITS MATTER AT REST ($v = 0$ **).**

But both matters, of the electrostatic as well as of the gravitational field, are electromagnetic, and despite having different structures, they come from a homogenous initial source.

4.3. ELECTROMAGNETIC MECHANISM OF INERTIAL FORCE FORMATION

Proceeding from the fact that kinetic energy is magnetic and for an electron at velocity $\vec{v} = \vec{a}.t$, where $\vec{a}$ is its acceleration, this circumstance means that when $\vec{a} \neq 0$, its magnetic (kinetic) energy alters, and respectively, magnetic flux Φ that encompasses the electron also alters. They increase when $\vec{a}$ is a positive value – the velocity increases and vice versa – when $\vec{a}$ is negative, the velocity decreases. This alteration of the magnetic energy, respectively of the magnetic flux is related to the alteration of the kinetic energy, which is also related to Faraday's law of induction, i.e. according to Faraday's law, the alteration of magnetic flux in time $\dfrac{d\Phi}{dt}$ results in generation of eddy-current electric field $\vec{E}_i$

$$\text{a) } \frac{d\Phi.\vec{i}_a}{dt} = -\vec{E}_i \text{ ; b) } \vec{i}_a = \frac{\vec{a}}{|\vec{a}|};$$ (4.3-1)

This circumstance also implies the law that with any alteration of the kinetic (magnetic) energy of the electron, eddy-current electric field $\vec{E}_i$ is induced in it, according to (4.3-1) in direction opposite to the acceleration

$$\vec{a} = \frac{\vec{F}_d}{m_{e0}};$$ (4.3-2)

as a result of the motive force $\vec{F}_d$ and inertial force $\vec{F}_{ie} = q_e.\vec{E}$ occurs.

I.e. force $\vec{F}_{ie}$ is in opposite direction to force $\vec{F}_d$ and therefore force $\vec{F}_{ie}$ is the inertial force of the electron.

Below follows a detailed solution for the acquisition of the expression of the inertial force.

Through cross-section dS on a plane, going through the center of the electron and perpendicular to acceleration $\vec{a}$, with dimension $l_o = 1$, perpendicular to $\vec{r} \perp \vec{l}_0$ and dimension dr along $\vec{r}$ in point M, i.e. $dS = l_0\,dr = 1.dr$, runs elementary magnetic flux $d\Phi_e = B.dS$. The flux, which encompasses the electron through the center and along a unit of length on the axis of $\vec{a}$ is:

$$\text{a) } \Phi_e = \int_{r_{e0}}^{\infty} d\Phi_e = \frac{q_e.a.t}{4.\pi.\varepsilon_0.r_{e0}.c^2} = \frac{m_{e0}.a.t}{q_e}\text{ ; b) at } a = 0 \rightarrow \Phi_e = 0; \tag{4.3-2}$$

The derivative of Φ_e by the time, according to Faraday's law induces electromotive field E_{ei} in the center of the electron in direction, opposite to acceleration $\vec{a}$

$$\vec{E}_{ei} = -\frac{d\Phi_e.\vec{i}_a}{dt} = -\frac{q_e.a.\vec{i}_a}{4.\pi.\varepsilon_0.r_{e0}.c^2} = -\frac{m_{e0}.\vec{a}}{q_e}\text{ ; } \vec{i}_a = \frac{\vec{a}}{|\vec{a}|}\text{ ;} \tag{4.3-4}$$

This $\vec{E}_{ei}$ field by its interaction with the electric charge q_e of the electron generates electromagnetic force

$$\text{a) } \vec{F}_{ie} = q_e.\vec{E}_{ei} = -m_{e0}.\vec{a}\text{ ;} \tag{4.3-5}$$

which is equal in value and opposite in direction to the motive forces which set the electron into motion

$$\text{a) } \vec{F}_d = q_e.\vec{E}_B = \vec{F}_e\text{ ; b) } \vec{F}_d = m_e.\vec{G} = \vec{F}_G\text{ ; c) } \vec{F}_{ie} = -\vec{F}_d = -\vec{F}_e = -\vec{F}_G\text{ ;} \tag{4.3-6}$$

or

$$\vec{F}_d + \vec{F}_{ie} = 0\text{ ;} \tag{4.3-7}$$

where: $\vec{G}$ is gravitational field.

In this sense, $\vec{F}_{ie}$ is the inertial force, which in the sense of Newton is:

$$\text{a) } \vec{F}_i = -m.\vec{a} = -\vec{F}_d\text{ ; b) } \left|\vec{F}_i\right| = \left|\vec{F}_d\right|\text{ ;} \tag{4.3-8}$$

i.e. the inertial force is electromagnetic in essence and is a result of a self-action of the electron upon itself. *Essentially, the inertial force is a manifestation of the Law for conservation of the mass and the energy of an object, by counteracting against the external factor, which aims at altering them (the motive force $\vec{F}_d$) with the same value, but with an opposite sign, so that their sum is zero $\vec{F}_i + \vec{F}_d = 0$ or the object retains its mass and energy.*

This solution for the inertial force is a result of the fact that kinetic energy is magnetic energy.
Hence this inference follows:
THE ALTERATION OF MAGNETIC (KINETIC) ENERGY RESULTS IN GENERATION OF INERTIAL FORCE.
In the general case, the acceleration, which is a vector quantity

$$\text{a) } \vec{a} = \vec{a}_\tau + \vec{a}_n\text{; b) } a^2 = a_\tau^2 + a_n^2; \tag{4.3-9}$$

where: $\vec{a}_\tau$ is the component as a projection of the acceleration $\vec{a}$ upon the initial velocity $\vec{v}_0$ of the electron, which can be of sign plus (+) or minus (-), i.e. energy could be imparted $\Delta W_\tau = \frac{m_{e0}.v_\tau^2}{2} > 0$, or taken away $\Delta W_\tau = \frac{m_{e0}.v_\tau^2}{2} < 0$. A $\vec{a}_n$ is the component as a projection of $\vec{a}$ upon an axis perpendicular to velocity $\vec{v}_0$ of the electron. ***In these conditions, taking energy away means that the electron will release energy in the form of magnetic energy to other objects, or as emitted in the form of electromagnetic energy emitted as electromagnetic waves (photons), to the surrounding space. In support of these thoughts, comes this circumstance:***
The released energy dW_a is

$$dW_a = \vec{F}_i.\Delta\vec{v}.dt = m.a.t.dt = q_e^2.k_m.a.t.dt; \tag{4.3-10}$$

and the emitted energy dW_u, according to literature about the electron is proportional

$$dW_u \equiv q_e^2 . a^2 \; ; \tag{4.3-11}$$

i.e. dW_u is part of dW_a proportional to $q_e^2 . a^2$. For electrons in atoms with circular velocity appr. $v_{e_0} = 10^6$ m/s and acceleration (tangential), which reduces this velocity to $v_e^{'} < v_{e0}$ and is the reason (according to the Law of conservation of kinetic and potential energies of the electron in an atom) for its distance to the nucleus to decrease and normal acceleration to be generated, which increases its potential energy. In this case the decreased kinetic (magnetic) energy is emitted in the form of photons.

Similarly, with Compton's effect. Part of the energy of the photon which strikes the electron (its value being equal to the potential energy of the electron) is emitted by the electron, and another part of the energy of the striking photon is spent on accelerating the electron.

CHAPTER FIVE
EMISSION OF ELECTROMAGNETIC ENERGY BY ELECTRONS IN THE FORM OF ELECTROMAGNETIC WAVES – PHOTONS

5.1. WHEN AN ELECTRON HITS A HARD SURFACE

According to electrodynamics, during the motion of electrons at acceleration $\vec{a}$, they emit power

$$N = \frac{dW}{dt} = \frac{2}{3} . \frac{q_e^2 . a^2}{c^3} \; ; \tag{5.1-1}$$

When an electron hits a hard surface at velocity v_0 and is absorbed by the surface, its velocity becomes equal to zero. If the duration of the collision is τ, the mean acceleration of the electron is:

$$\vec{a} = \frac{\vec{v}_0}{\tau} \; ; \tag{5.1-2}$$

Provided that pathway r_a, along which the velocity v_0 becomes zero (from v_0 and 0), is equal to the diameter of the electron $r_a = D_{e0} = 2.r_{e0}$, and the velocity $v_0 = 10^6 \, \mathrm{m.s^{-1}}$, the time is:

$$\tau = \Delta t = \frac{r_a}{v_0} = \frac{D_{e0}}{v_0} = \frac{5.62.10^{-15}}{10^6} = 5,62.10^{-21} \mathrm{s} \; ; \tag{5.1-3}$$

At velocity of the electron v_0 of the order of the velocities of electrons in the atom $v_0 \approx 10^6 m.S^{-1}$ and $r_{e0} = 2.81.10^{-15} m$, the acceleration in the collision is:

$$a = \frac{v_0}{\tau} = \frac{10^6}{5,62.10^{-21}} \approx 1,77.10^{26} \mathrm{m.s^{-2}} \; ; \tag{5.1-4}$$

From formula (5.1-1) by replacing the participating quantities with numerical values and multiplying by time τ, we derive the emitted wave energy:

$$\Delta W = N.\tau = 9,98.10^{-18} \mathrm{J} \; ; \tag{5.1-5}$$

which is of the order of the energy of a photon with frequency $\nu = 10^{16}$ Hz (in the ultraviolet spectrum), which is:

$$W_e = h.\nu = 6,625.10^{-34}.10^{16} = 6.625.10^{-18} \mathrm{J} \; ; \tag{5.1-6}$$

here the accepted velocity $v_0 = 10^6 \mathrm{s^{-2}}$ is just tentative.

At velocities $v_0 = 10^2 \div 10^3 \mathrm{m.s^{-1}}$, it follows that $a = 1,77 \left(10^{23} \div 10^{24} \right) \mathrm{m.s^{-2}}$ and $\Delta W = $

$= 9,98. \left(10^{-26} \div 10^{-24} \right)$ J , and the frequency of photons is $\nu = 9,98. \dfrac{\left(10^{-26} \div 10^{-24} \right)}{6,625.10^{-34}} = 1,5. \left(10^8 \div 10^{10} \right)$ Hz

With regard to the emission of energy from the electrons in connection with the direction of the velocity of the electron $\vec{v}_e$ and the direction of acceleration $\vec{a}_e$, which is determined by the direction and value of the acting force $\vec{F}_d = m.\vec{a}$, where m_e is the mass, connected with the force of electrons m_e, where the acceleration of the electron is:

$$\vec{a}_e = \frac{\vec{F}_d}{m_e} \; ; \tag{5.1-7}$$

Here, the following rule holds true:

The projection of the acceleration $\vec{a}_e$ upon velocity $\vec{v}_e$ of the electron $\vec{a}_{ea}$ is called active, because only when $\vec{a}_{ea} \neq 0$ has force $\vec{F}_d$, which generates this acceleration, a projection $\vec{F}_{d\tau} \neq 0$ upon the velocity $\vec{v}_e$ of the electron. And only then the product of the elementary part of the trajectory of the electron

$$d\vec{r}_e = \vec{v}_e.dt \; ; \tag{5.1-8}$$

multiplied by force $\vec{F}_{da}$ gives energy different from zero, i. e.

$$dW_e = \vec{F}_{d\tau}.d\vec{r}_e = F_{d\tau}.dr_e.\cos 0 \neq 0 \; ; \tag{5.1-9}$$

Id est only on condition (5.1-9) does the force acting on the electron $\vec{F}_{d\tau}$, which moves at velocity $\vec{v}_e$, imparts the real value of energy dW_e to it. And depending on the sign of this energy $dW_e \neq 0$, it accelerates ($\vec{v}_e$ increases) or decelerates ($\vec{v}$ decreases) the electron. Or, in other words, depending on the sign of dW_e (5.1-9), the kinetic energy of the electron increases or decreases.

If the projection of the acceleration $\vec{a}_e$ upon velocity $\vec{v}_e$ is zero (i. e. the acceleration is perpendicular to $v_e \rightarrow \vec{a}_e \perp \vec{v}_e$), then the acceleration is passive $\vec{a}_{en}(\vec{a}_{en} \perp \vec{v}_e)$. In this case dW_e is:

a) $dW_e = \vec{F}_{d\tau}.d\vec{r}_e = F_{d\tau}.dr_e.\cos\dfrac{\pi}{2} = 0$; b) $\vec{F}_{d\tau} \perp \vec{v}_e$; c) $d\vec{r} = \vec{v}_e.dt$; $\tag{5.1-10}$

Id est in case $\vec{a}_{ep} \perp \vec{v}_e$, the force $\vec{F}_{dp} = m.\vec{a}_{er}$ is perpendicular to the velocity of the electron, too, and because of this it does not give out energy to the electron, **owing to which the electron does not change its energy, and thus the force $\vec{F}_{dn}$, or acceleration $\vec{a}_{en}$ respectively, changes only the direction of its velocity.**

THIS FACT DISPROVES N. BOHR'S ARGUMENT FOR THE ATOM MODEL THAT THE FACT THAT THE ELECTRON DOES NOT FALL ON THE ATOM NUCLEUS, IS NOT AN EFFECT FROM CLASSICAL PHYSICS. *For example, if the electron is in the orbital of the atom, under the action of this force (acceleration), the electron will move constantly only along one orbital – it will neither fall down onto nucleus, nor move up to a higher orbital.*

5.2. GENERAL ASSUMPTIONS ABOUT THE EMISSION OF A PHOTON BY THE ELECTRONS IN THE ATOMS

1. The electron has electric charge $q_e = -1,6.10^{-19} C$.

2. The mass of the electron at the velocity $v_e \approx 10^6 m.s^{-1} \ll c$ in the orbital of the atom is

$$m_{e0}\left(1 - 1,11.10^{-4}\right) \approx m_{e0} = q_e^2.k_m : k_m = \left(4.\pi.\varepsilon_0.r_{e0}.c^2\right)^{-1} \; ; \tag{5.2-1}$$

3. In the atom of hydrogen, its nucleus has charge $q_я = -q_e = +1,6.10^{-19} C$.

4. The electric potential V_e and the potential energy W_{ep} of the electron, which is in the orbital at distance

a) $r_e = n^2.r_0$; b) $n = 1; 2; 3...integer$; $\tag{5.2-2}$

where: r_0 is the smallest value of the radius of the electron in the atom, therefore the potential and the potential energy of the electron are:

$$\text{a) } V_\text{e} = \frac{q_\text{e}}{4.\pi.\varepsilon_0.r_\text{e}} \text{ ; b) } W_{\text{ep}} = \frac{q_\text{e}.q_\text{я}}{4.\pi.\varepsilon_0.r_\text{e}} = \frac{q_\text{e}.q_n}{4.\pi.\varepsilon_0.r_0.n^2} \text{ ;} \tag{5.2-3}$$

which are quantized, because they are functions of q_e and $q_\text{я}$, which are quantized electric charges, because q_e is the smallest quantum (quantity) of electric charge, or from (5.2-3) we have

$$\text{a) } q_\text{e} = V_\text{e}.4\pi.\varepsilon_0.r_\text{e} \text{ ; b) } q_\text{e}.q_\text{я} = W_{\text{ep}}.4\pi\varepsilon_0.r_\text{e} \text{ ; c) } r_\text{e} = n^2.r_0 \text{ ;} \tag{5.2-4}$$

It is evident from (5.2-4) that the distances r_e should be quantized

4. The force – Coulomb's law is a derivative of W_{ep} (5.2-3)b relative to r_e

$$F_{\text{kk}} = F_\text{e} = \frac{\text{d}W_{\text{ep}}}{\text{d}r}.\vec{r}_0 = \frac{q_\text{e}.q_\text{я}.\vec{r}_0}{4.\pi.\varepsilon_0.r_\text{e}^2} \text{ ; } \vec{r}_0 = \frac{\vec{r}_\text{e}}{\left|\vec{r}_\text{e}\right|} \text{ ;} \tag{5.2-5}$$

5. From (5.2-4) the energy

$$\text{a) } \text{d}W_{\text{ep}} = \vec{F}_{\text{kk}}.\text{d}\vec{r} \text{ ; b) } W_{\text{ep}} = -\int_\infty^{r_\text{e}} \frac{q_\text{e}.q_\text{я}.\vec{r}_0.\text{d}\vec{r}_\text{e}}{4.\pi.\varepsilon_0.r_\text{e}^2} = \frac{q_\text{e}.q_\text{я}}{4.\pi.\varepsilon_0.r_\text{e}} = \frac{q_\text{e}.q_\text{я}}{4.\pi.\varepsilon_0.n^2.r_0} \text{ ;} \tag{5.2-6}$$

therefore, the magnetic (kinetic) force F_{kk} is quantized as well.

6. The full energy W_0 of the electron in the atom at velocity v_e is a sum of the potential energy W_{ep} and the magnetic (kinetic) energy $W_H = W_\text{k} = \frac{m_{\text{e0}}.v_\text{e}^2}{2}$

$$W_0 = W_{\text{ep}} + W_\text{k} = -\frac{q_\text{e}^2}{8.\pi.\varepsilon_0.r_\text{n}} + \frac{m_{\text{e0}}.v_\text{e}^2}{2} \text{ ; } r_\text{n} = n^2.r_0 \text{ ;} \tag{5.2-7}$$

where: $W_K = W_H$ is the kinetic energy of the electron at $v_e \ll c$.

It is evident from (5.2-7)) that the full energy of the electron in the atom is quantized, too.

7. Forces and energies during absorption and emission of a photon with energy W_f and mass $m_\text{f} = \frac{W_\text{f}}{c^2}$ of the photon.

A hydrogen atom is interpreted, its full energy in stationary mode being W_0 (5.2-7).

In a stationary mode, the electron moves along a stationary orbital with $r = r_\text{n} = \text{const.}$ owing to which the centripetal $\vec{F}_\text{c}$ and centrifugal $\vec{F}_\text{j}$ are numerically equal, but with opposite directions, i. e.

$$\text{a) } \vec{F}_\text{i} + \vec{F}_\text{j} = 0 \text{ ; } \rightarrow \text{b) } \left|\vec{F}_\text{i}\right| = \left|\vec{F}_\text{j}\right| = F_\text{n} \text{ ;} \tag{5.2-8}$$

Since forces $\vec{F}_\text{i}$ and $\vec{F}_\text{j}$ are derivatives of their energies $W_H = W_K$; therefore, their energies are equal as well

$$\text{a) } W_{\text{ep}} = W_\text{k} \text{ ; } \rightarrow \text{b) } \frac{q_\text{e}^2}{4.\pi.\varepsilon_0.r_\text{n}} = \frac{m_{\text{e0}}.v^2}{2} \text{ ;} \tag{5.2-9}$$

therefore, the radius is

$$r_\text{n} = \frac{q_\text{e}^2}{4.\pi.\varepsilon_0.m_{\text{e0}}.v_\text{e}^2} = n^2.r_0 \text{ ;} \tag{5.2-10}$$

And the values of forces $\vec{F}_\text{i}$ and $\vec{F}_\text{j}$ or F_n are

$$F_\text{n} = \left|\vec{F}_\text{i}\right| = \left|\vec{F}_\text{j}\right| = \left|\frac{\text{d}W_\text{n}}{\text{d}r}.\vec{r}_0\right| = \left|\frac{\vec{v}_\text{e}.\text{d}\vec{P}_\text{e}}{v.\text{d}t}\right| = \left|\frac{\text{d}\vec{P}_\text{e}}{\text{d}t}\right| = \left|m_{\text{e0}}.\frac{\text{d}\vec{V}_\text{e}}{\text{d}t}\right| = \left|m_{\text{e0}}.\vec{a}_\text{n}\right| \text{ ;} \tag{5.2-11}$$

To these forces correspond equal in values centripetal $\vec{a}_\text{i}$ and centrifugal $\vec{a}_\text{j}$ accelerations, which have opposite directions

a) $|\vec{a}_i| = |\vec{a}_j| = |\vec{a}_n| = \left|\dfrac{v_n^2}{r_n}.\vec{r}_0\right| = \left|-\omega^2.r_n\right|$; b) $\vec{a}_i + \vec{a}_j = 0$; c) $\omega = 2.\pi.\nu$; d) $v_n = \omega.r_n$; e) $\vec{r}_0 = \dfrac{\vec{r}_n}{|\vec{r}_n|}$;   (5.2-12)

where: ω is the angular frequency of the electron at radius of the orbital r_n ; ν - the frequency of the revolutions of the electron along the orbital with r_n

8. In a stationary mode, the accelerations $\vec{a}_i$ and $\vec{a}_j$ are perpendicular to velocity $\vec{v}_n$ of the electron upon the orbital with radius r_n , i. e.

a) $\vec{a}_i \perp \vec{v}_n$; b) $\vec{a}_j \perp \vec{v}_n$;   (5.2-13)

Therefore, forces $\vec{F}_i$ and $\vec{F}_j$ are perpendicular to velocity $\vec{v}_n$ as well, i. e.

a) $\vec{F}_i \perp \vec{v}_n$; b) $\vec{F}_j \perp \vec{v}_n$;   (5.2-14)

since

a) $\vec{F}_i = m_{e0}.\vec{a}_i$; b) $F_j = m_{e0}.\vec{a}_j$;   (5.2-15)

Because of this (5.1-25) and because d$\vec{r}_n = \vec{v}_n.\mathrm{d}t$, the work, which they do or the energy needed to change the energy of the electron, is zero, i. e.

a) $\mathrm{d}A_i = \mathrm{d}W_i = \vec{F}_i.\mathrm{d}\vec{r}_n = \vec{F}_i.\vec{v}_n.\mathrm{d}t = F_i.v_n.\mathrm{d}t.\cos\dfrac{\pi}{2} = 0$;

b) $\mathrm{d}A_j = \mathrm{d}W_j = \vec{F}_j.\vec{v}_n.\mathrm{d}t = F_j.v_n.\mathrm{d}t.\cos\dfrac{\pi}{2} = 0$;   (5.2-16)

Because of this (5.2-16), the energy of the electron does not change in a stationary mode along one orbital and it constantly moves along the same orbital and does not fall down onto the nucleus. The reason for this is (5.2-16) that the sum of the attractive (centripetal) force $\vec{F}_i$ and the centrifugal force $\vec{F}_j$ in a stationary mode neutralize each other: their sum is zero (5.2-8)a.

THIS CONCLUSION, WHICH HAS ALSO BEEN EXPERIMENTALLY VALIDATED, DISPROVES NIELS BOHR'S CLAIMS, WHEN REFERRING TO THE ATOM MODEL, THAT THIS DOES NOT RESULT FROM CLASSICAL PHYSICS, BUT IS SOMETHING NEW, A FACT FROM THE QUANTUM MECHANICS. BUT AS WE HAVE SHOWN, IT IS A PURELY CLASSICAL EFFECT RESULTING FROM THE CLASSICAL ELECTRODYNAMICS.

10. Therefore, in order to change the energy of an electron, which is in an atom orbital and moves at velocity $\vec{v}_e$, it is necessary that the angle θ between the force $\vec{F}_i$, which acts upon it and its velocity v_e should be under an angle different from $\dfrac{\pi}{2}$, i. e.

$$\theta \neq \dfrac{\pi}{2} ;$$ (5.2-17)

or the acceleration $\vec{a}_i$ which is imparted to it should be under an angle θ different from $\dfrac{\pi}{2}$ relative to its velocity $\vec{v}_e$, so that the shift $\mathrm{d}\vec{r}_n = \vec{v}_n.\mathrm{d}t$ should not be perpendicular to force $\vec{F}_i$ and the product of $\vec{F}_i$ by $\mathrm{d}\vec{r}_n$, which is equal to work $\mathrm{d}A_i$ and energy $\mathrm{d}W_i$ be different from zero, i. e.

$$\mathrm{d}A_i = \mathrm{d}W_i = \vec{F}_i.\mathrm{d}\vec{r}_e = \vec{F}_i.\vec{v}_e.\mathrm{d}t = F_i.v_n.\mathrm{d}t.\cos\theta \neq 0 ;$$ (5.2-18)

In (5.2-18), two radically different solutions are possible depending on the value of angle θ .

10.1. When angle θ is smaller than $\dfrac{\pi}{2}$.

Then force $\vec{F}_i$ (the acceleration $\vec{a}_i$) has a component (projection) $\vec{F}_i^{'}$ ($\vec{a}_i^{'}$) upon the direction of velocity $\vec{v}_e$, owing to which it increases to $v_e^{'} > v_e$, and this entails an increases of the kinetic energy of the electron from W_k to $W_k^{'} > W_k$. Since the sum of the kinetic energy W_k (magnetic energy W_H) and the potential energy W_{ep} of the electron must remain constant, the potential energy, therefore, must decrease to $W_{ep}^{'} < W_{ep}$ by gaining ΔW_k of the kinetic (magnetic) energy, and this means that the radius r_n of the orbital will increases to $r_n^{'} > r_n$ or, proceeding from (5.2-9)e, we have

a) $W'_{ep} = \dfrac{q_e^2}{4.\pi.\varepsilon_0.r'_n} = \dfrac{m_{e0}.v'^2_e}{2}$; b) $r'_n = \dfrac{2.q_e^2}{4.\pi.\varepsilon_0.m_{e0}.v'^2_e} > r_n$; $\qquad$ (5.2-19)

i. e. at $\theta < \dfrac{\pi}{2}$ the electron moves to a higher orbital with $r'_n > r_n$, where its potential energy is lower.

Such is the case when the electron absorbs, from outside, a photon with energy

a) $W_f = W'_H - W_H$; b) $W_H = W_K$; $\qquad$ (5.2-20)

10.2. When the angle θ is larger than $\dfrac{\pi}{2}$.

Then the projection of the force $\vec{F}_i$ (the acceleration $\vec{a}_i$) is in the opposite direction of velocity $\vec{v}_e$ of the electron, because of which its velocity decreases to $v''_e < v_e$, and hence its kinetic energy decreases as well to $W''_k < W_k$, and its potential energy increases $W''_{ep} < W_{ep}$, due to which the radius of its orbital decreases to $r''_n < r_n$; by analogy to (5.2-19), for r''_n we have

$$r''_n = \dfrac{2.q_e^2}{4.\pi.\varepsilon_0.m_{e0}.v''^2_e} < r_n$$; $\qquad$ (5.2-21)

and has kinetic energy W''_k and potential energy W''_{ep}

a) $W''_H = W_H - W_f = \dfrac{m_{e0}.v''^2_e}{2}$; b) $W''_{ep} = \dfrac{q_e^2}{4.\pi.\varepsilon_0.r''_n}$; $\qquad$ (5.2-22)

The decrease of W_k to W''_k is by the energy of the photon W_f, which is emitted in this process at $\theta > \dfrac{\pi}{2}$.

The presented herein contains the mechanisms of absorption and emission of photons by electrons in the atom, which is a classical fact.

EMPHASIS.

THE ANALYSES IN ITEMS 10.1 AND 10.2 ARE MADE ONLY THROUGH THE LAWS OF CLASSICAL PHYSICS (MECHANICS AND ELECTRODYNAMICS). AND THEY SHOW THAT THE PROCESSES OF ELECTRONS IN ATOMS (MOLECULES) OBEY THE LAWS OF CLASSICAL PHYSICS. *A CATEGORICAL CLAIM FOLLOWS FROM THIS FACT: THAT THE EMISSION AND ABSORPTION OF PHOTONS BY ATOMS (MOLECULES) ARE CLASSICAL PHENOMENA.*

It is another question that when electrons in atoms are more than one, they interact with each other and then there occurs interaction between three bodies (the nucleus and two or more electrons) and this problem presently has no solution in physics. That is why N. Bohr's model cannot solve problems with an atom having two or more electrons.

5.3. EMISSION OF PHOTONS BY ATOMS

Here it should be taken into account that the phenomena in atoms are determined by the phenomena of their electrons and their nuclei.

An electron in the orbital of an atom with radius r_i and velocity $v_i << c$ has magnetic energy W_{Hi}, to which, formally, corresponds frequency ν :

a) $W_{Hi} = \dfrac{m_{e0}.v_i^2}{2}$; b) $\nu_i = \dfrac{W_{Hi}}{h}$; $\qquad$ (5.3-1)

where: h – Planck's constant

Here the electron is in the central electric field $E_я$ of the nucleus, due to which upon it acts a central electric force

a) $\vec{F}_{csi} = q_e.\vec{E}_я = q_e.\dfrac{Q_я.\vec{r}_0}{4.\pi.\varepsilon_0.r_i^2} = m_{e0}.\vec{a}_{csi}$; b) $\vec{a}_{csi} = \dfrac{v_i^2}{r_i}\vec{r}_0$; $\qquad$ (5.3-2)

where: $Q_я$ is the charge of the nucleus. In the hydrogen atom, there is one electron with charge $-q_e$

By analogy to (5.1-9), $\vec{F}_{csi}$, acting along pathway dr_i must take away electromagnetic energy dW_{ei} from its magnetic energy W_{Hi} (called kinetic energy)

$$dW_{ei} = \vec{F}_{csi}.d\vec{r}_i = \frac{q_e^2}{4.\pi.\varepsilon_0.r_i^2}|\vec{r}_0|.|d\vec{r}_i|\cos\alpha_s < 0 \; ; \; d\vec{r}_i = \vec{v}.dt \; ; \tag{5.3-3}$$

If the projection of the acceleration $\vec{a}_{csi}$ upon the direction of velocity $\vec{v}_i$, is different from zero, i. e. $\vec{a}_{csi}$ has an active component on the axis of $\vec{v}_i$, under condition (5.1-13), as a result of the decreased magnetic energy, the electron will move to a lower orbital, of a smaller radius $r_j < r_i$, and the energy released at $|q_я| = |-q_e|$ (hydrogen atom) is:

$$W_{eij} = W_{fij} = \int_{r_i}^{r_j} dW_{ei} = \frac{q_e^2}{4.\pi.\varepsilon_0}.\left(\frac{1}{r_j} - \frac{1}{r_i}\right) = h.\nu_{ij} \; ; \tag{5.3-4}$$

Therefore, the magnetic energy of the electron W_{Hj} and its velocity v_j along the orbital of radius r_j are:

$$\text{a) } W_{Hj} = W_{Hi} - h\nu_{ij} = \frac{m_{e0}.v_i'^2}{2} \; ; \; \text{b) } v_i'^2 = v_i^2 - \frac{2.h.\nu_{ij}}{m_{e0}}.v_i^2 \; ; \tag{5.3-5}$$

From (5.3-5), on assigning:

$$\text{a) } r_i = r_0.n_i^2 \; ; \; \text{b) } r_j = r_0.n_j^2 \; ; \; \text{c) } n_i = 1,2... \; ; \; \text{d) } n_j = 1, 2,...; \tag{5.3-6}$$

while allowing for the experimental law of the frequency of the photon through Rydberg constant R, the result from (5.3-4) is

$$\text{a) } \nu = \frac{R}{r_0}\left(\frac{1}{n_j^2} - \frac{1}{n_i^2}\right) \; ; \; \text{b) } \frac{\nu}{R} = \frac{1}{r_0}.\left(\frac{1}{n_j^2} - \frac{1}{n_i^2}\right) \; ; \tag{5.3-7}$$

the formula (5.3-6) is written in the form:

$$W_{eij} = W_{eij} = \frac{q_e^2}{4.\pi.\varepsilon_0.r_0}.\left(\frac{1}{n_j^2} - \frac{1}{n_i^2}\right) = h.\nu_{ij} \; ; \tag{5.3-8}$$

And the value of Planck's constant is:

$$h = q_e^2\left(4.\pi.\varepsilon_0.r_0.R\right)^{-1} = \text{const.} \; ; \tag{5.3-9}$$

The energy of the photon at velocities v_i and v_j.

$$W_{fij} = W_{Hi} - W_{Hj} = \frac{m_{e0}}{2}.\left(v_i^2 - v_j^2\right) \; ; \tag{5.3-10}$$

5.4. ABSORPTION OF PHOTONS BY ATOMS

When a photon with energy $W_{f0} = h.\nu_0$ hits an electron in an atom with orbital of radius r_i, velocity $\vec{v}_i$; and magnetic energy $W_{нei} = \frac{m_{e0}.v_i^2}{2}$, and is absorbed by the atom, the magnetic energy of the electron increases to

$$W_{нej} = W_{нei} + W_{f0} = \frac{m_{e0}.v_j^2}{2} \; ; \tag{5.4-1}$$

And the velocity and its centrifugal acceleration become

$$\text{a) } v_j = v_i + \frac{2.W_{f0}}{m_{e0}} \; ; \; \text{b) } a_{ckj} = v_j/r_j > a_{ci} = v_i/r_i \; ; \tag{5.4-2}$$

Because of this centrifugal force F_{ekj} increases in relation to the attractive force at the orbital with $r_j - |\vec{F}_{ckj}| > |\vec{F}_{cei}|$ and the electron moves along distance Δr_{ij} into a higher orbital with radius $r_j > r_i$, i. e.

$$r_j = r_i + \Delta r_{ij} \approx r_i + \frac{W_{R0}}{F_{ekj}} \approx r_i + \frac{W_{R0}}{m_{e0}.a_{ckj}} \; ; \tag{5.4-3}$$

5.5. EMISSION OF ELECTROMAGNETIC WAVES IN EXTERNALLY ELECTRICALLY NEUTRAL BODIES (OBJECTS)

We take the electron as a model of an electrically neutral body.
The electron at rest has mass

$$a)\ m_{e0} = \left(\mp q_e\right)^2.k_m;\quad b)\ k_m = \left(4.\pi.\varepsilon_0.r_{e0}.c^2\right)^{-1} = \text{const.} \tag{5.5-1}$$

where: $\left(-q_e\right)^2 > 0$ is the value of the square of the electric charge of the electron, which is called here effective square of the electric charge of the electron; ε_0 – the dielectric constant of vacuum; r_{e0} – computational (classical) radius of electromagnetic waves (light) in vacuum.

The value of the constant k_m is

$$k_m = \left(4.\pi.8,85.10^{-12}.2,81.10^{-15}.9.10^{16}\right)^{-1} = \left(2811,132\right)^{-1} = 3,55.10^7$$

$$a)\ q_e^2 = \frac{m_{e0}}{k_m} = \frac{9,1.10^{-31}}{3,55.10^7} = 2,56.10^{-38}\left[C^2\right];\quad b)\ q_e = 1,6.10^{-19}\left[C\right]; \tag{5.5-2}$$

For a body of mass m_m the square of its effective charge, according to Chapter One, paragraph 5, by analogy to the electron, should be

$$Q_m^2 = \frac{m_T}{k_m} = m_T.2,81.10^8\left[C^2\right]; \tag{5.5-3}$$

This charge Q_m^2 has a different value from the square of the sum of the real charge Q_p^2, i.e.

$$Q_T^2 \neq Q_p^2; \tag{5.5-4}$$

It can be operated with these squares of the effective charges in the same way as with the square of the charge of the electron q_e^2 when calculating the masses and energies (the full W_m and the internal W_{m0}) of the bodies at velocity v.

$$a)\ m_T = Q_m^2.k_m\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}};\quad b)\ W_T = m_T.c^2 = Q_m^2\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}.c^2; \tag{5.5-5}$$

$$W_{T0} = m_0.c^2 = Q_m^2.k_m.c^2; \tag{5.5-6}$$

The magnetic (kinetic) energy of the body is

$$W_H = W_K = W_T - W_{T0} = Q_m.k_m.c^2\left[\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}-1\right] = m_{T0}.c^2\left[\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}-1\right]; \tag{5.5-7}$$

which expression is in complete compliance with the description of the electron.

Under these conditions, proceeding from the formula of the power emitted by the electron[*]

$$\frac{dW}{dt} = N = \frac{2}{3}.\frac{q_e^2.a^2}{c^3}; \tag{5.5-8}$$

it follows that a body of mass $m = 1\,kg$ at acceleration 10^3 m/s^2, which has a square of the effective electric charge

$$Q_T^2 = \frac{m_T}{k_m} = \frac{1}{3,55.10^7} = 0,281.10^{-7} = 2,81.10^{-8}\left[C^2\right]; \tag{5.5-9}$$

emits power (energy per second)

$$N = \frac{2}{3}.\frac{2,81.10^{-8}.10^6}{27.10^{24}} = \frac{5,62.10^{-2}}{3.27.10^{24}} = 9,33.10^{-30}\left[\text{W}\right]; \tag{5.5-10}$$

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[*] Encyclopedic Dictionary of Physics. Publ. Soviet Encyclopedia. Moscow. 1984. (p. 206).

5.6. ESSENCE AND CONSEQUENCES OF PLANCK'S CONSTANT

As it has already been ascertained, in annihilation of e_0^- and positron e_e^+ at $v \approx 0$, photons are generated $\left(e_0^- + e_0^+\right) \to 2.\gamma$, whose wave length coincides with the length of the wave of Compton $\lambda_k = 2.42.10^{-13} m$, which is in essence electromagnetic, and Planck's constant determined by this reaction (interaction) is

$$\text{a) } h = \frac{m_{e0}.c^2}{\nu} = \frac{W_{e0}}{\nu_k} = \frac{q_e^2.k_e.c^2}{\nu_k} = q_e^2.k_e.c.\lambda_k; \text{ b) } \frac{\text{electromagnetic energy}}{\text{frequency}} \to [\text{J.S}];\tag{5.6-1}$$

Similarly, for protons p and neutrons n, which at annihilation generate photons with respective Compton lengths of waves and frequencies

$$\text{a) } p_0 + \overline{p}_0 \to 2.\gamma_p \text{ ; b) } n + \overline{n}_0 \to 2.\gamma_n \text{ ; b) } 2.m_{p0}.c^2 = 2h.\nu_p \text{ ; d) } 2.m_{n0} = 2.h.\nu_n \text{ ;}\tag{5.6-2}$$

where the lengths and frequencies of Compton waves are

$$\text{a) } \lambda_{kp} = \frac{h.c}{m_{p0}.c^2} = \frac{h}{m_{p0}.c} = 13,19.10^{-16} m \text{ ; b) } \nu_{pk} = \frac{c}{\lambda_{kp}} = 2,27.10^{15} Hz \text{ ;}\tag{5.6-3}$$

$$\text{a) } \lambda_{kn} = \frac{h.c}{m_{no}.r^2} = \frac{h}{m_{n0}.c} = 13,19.10^{-16} m \text{ ; b) } \nu_{nk} = \frac{c}{\lambda_{kn}} = 2,274.10^{15} Hz \text{ ;}\tag{5.6-4}$$

It is apparent from the presented above that in essence h is constant only when determining the energy of electromagnetic waves emitted by atoms for a finite time interval of n periods $t = \dfrac{1}{\nu} - \tau = n.T_0$. *Therefore, Planck's constant can only be used for electromagnetic waves, as well as for Compton waves, which are only electromagnetic waves of fixed frequency* ν_k *and length of the wave* λ_k. **THE FACT THAT IT IS USED FOR ALL ELEMENTARY PARTICLES SPEAKS THAT IT IS IMPLICITLY ACKNOWLEDGED THAT ESSENTIALLY THEY ARE ONLY OF ELECTROMAGNETIC ESSENCE (I.E. ALL ELEMENTARY PARTICLES ARE ONLY OF ELECTROMAGNETIC ESSENCE) AND CAN BE RESTRUCTURED FROM A SUBSTANTIAL FORM INTO A FIELD FORM AND VICE VERSA.**

CHAPTER SIX
WAVE PROCESSES

6.1. INTRODUCTION

Here it should be pointed out that when doing new research work, we must always and obligatory use the laws and formulations that have been validated by the respective time of the study, only these laws and formulations that are relevant and adequate (reliable) at the time of the study and that hold true for the respective scientific field. This requirement is the first and initial position for the first step toward further reliable studies.

When studying velocities of material wave processes relative to the hitherto approach, there are three new reliable scientific facts:

First. Matter (mass) is unitary in nature (essence) and is only electromagnetic, and it exists in a field or substantial form, as it has been proven before.

Second. Wave processes of these two forms of electromagnetic matter are described by two wave equations, whose mathematical structure is identical. In general, they are the same wave equation of the quantities, characterizing the diverse quantities of the substantial form, indexed B, and the field form, indexed C, of electromagnetic matter, from which we can obtain the respective specialized differential wave equations:

$$\text{a) } \frac{\partial^2 y_B}{\partial t^2} = v_0^2.\frac{\partial^2 y_B}{\partial r^2}; \text{ b) } \frac{\partial^2 y_C}{\partial t^2} = c^2.\frac{\partial^2 y_C}{\partial r^2}; \to \text{ c) } \frac{\partial^2 y}{\partial t^2} = w^2.\frac{\partial^2 y}{\partial r^2},\tag{6.1-1}$$

where in the physical sense y, t, x, and the velocities $v_0 = c = w$ are identical in a qualitative aspect, but in a quantitative aspect they are different, due to the different forms (substantial and field structures) of matter.

Third. The solutions to the two equations (6.1-1) a and (6.1-1) b have the same form, which, notated so as to correspond to the substantial and field forms of their electromagnetic energy, in a most general case (6.1-1) c (without the indexes "b" and "c") is:

$$y = y_0 \sin \omega \left(t - \frac{r}{w} \right);$$

(6.1-2)

where: y_0 is the amplitude of the wave; $\omega = 2.\pi.\nu$ – the angular frequency; ν – the frequency of the wave; t – the time, r – the distance from the assumed start of describing the wave process; v_0 – wave velocity for the substantial form of matter; c – wave velocity for the field form of matter, w – the velocity without index, which, depending on the form of matter is equal to v_0 or to c $(w = v_0; w = c)$.

In classical physics, these relationships are given for velocities:

a) $w = \nu.\lambda$; b) $w_B = v_B.\lambda_B = v_0$; c) $v_C.\lambda_C = c$;

(6.1-3)

where: $\lambda = \dfrac{w}{\nu} \rightarrow \left(\lambda_B = \dfrac{v_0}{v_B}; \lambda_C = \dfrac{c}{v_C} \right)$ and $\nu = \dfrac{w}{\lambda} \rightarrow \left(\nu_B = \dfrac{v_0}{\lambda_B}; \nu_C = \dfrac{c}{\lambda_C} \right)$ are the wave length and the frequency of the respective substantial or field wave process. *It should be noted that up to this moment, the existence of a wave process has only be proven for the electromagnetic field. For the gravitational field, there is no known (recognized) independent (without electromagnetic waves) wave process.*

6.2. MASS, ENERGY AND VELOCITY OF MECHANICAL AND ELECTROMAGNETIC WAVE PROCESSES

6.2.1. General formulations

If the well-known expression for the force $\vec{F}$, which according to Newton is equal to the derivative of momentum $\vec{P}$ relative to time t, is multiplied and divided by velocity $\vec{v}$, we have the derivative of the energy relative to pathway r:

a) $\vec{F} = \dfrac{d\vec{P}}{dt} . \dfrac{\vec{v}}{\vec{v}} = \dfrac{dW}{dr} . \vec{r}_0$; b) $dW = \vec{v} . d\vec{P}$; c) $d\vec{r} = \vec{v} . dt$; d) $\vec{r}_0 = \dfrac{\vec{r}}{|\vec{r}|}$;

(6.2-1)

In fact, this relationship is not new, it is known from classical physics, where it is assumed that work A is equal to the product of force $\vec{F}$ and pathway $\vec{r}$ $(A = \vec{F}.\vec{r})$, since the quantity of work A is a measure of the quantity of energy W or

a) $dA = \vec{F}.d\vec{r} = dW$; b) $\vec{F} = \dfrac{dA}{dr} . \vec{r}_0 = \dfrac{dW}{dr} . \vec{r}_0$;

(6.2-2)

In this aspect, the notion of force, in a general, explicit form, has the meaning of energy exchanged between interacting objects for a unit of pathway. In this sense, the notion of interaction leads to the known interpretation that during interaction, energy and matter are exchanged, since every quantity of energy has the respective quantity of matter as its carrier. Id est, this idea was implicitly present even in classical physics, according to Newton, who used only the derivative of the momentum, viz. in the sense that matter and the energy during interaction change in a quantitative way.

If (6.2-1) is written for the substantial and field form of electromagnetic matter – of matter in general – using the respective notations for masses m_B and m_C, for energies W_B and W_C and for velocities v_B and v_C , we arrive at the classical relationships:

a) $dW_B = v_B.dP_B = v_B^2.dm_B$; b) $dW_C = v_C.dP_C = v_C^2.dm_C$;

(6.2-3)

where at substantial and field wave velocities $v_B = v_0$, $v_C = c$

a) $dW_B = v_B.dP_B = v_0^2.dm_B$; b) $dW_C = v_C.dP_C = c^2.dm_C$;

(6.2-4)

since in a most general case, at variable mass - $m \neq$ const.

a) $dP_B = m_B.dv_B + v_B.dm_B = \dfrac{dW_B}{v_B}$; b) $dP_C = m_C.dv_C + v_C.dm_C = \dfrac{dW_C}{v_C}$;

(6.2-5)

The classical description of the relationships of wave processes that they generate force, pressure, should be specified by taking into consideration Lord Rayleigh's law of 1902, which states: **"All wave processes generate force (pressure) upon the surface they fall":**

$$\text{a) } \vec{F} = \frac{dW}{dr}.\vec{r}_0 = \frac{d\vec{P}}{dt}; \text{ b) } dr = c.dt; \text{ c) } \vec{r}_0 = \frac{\vec{r}}{|\vec{r}|}; \tag{6.2-6}$$

Here W is the wave energy of n waves, which falls upon the surface for a given time $t = n.T$, it has momentum:

$$\text{a) } \vec{P} = \vec{F}.t = \frac{W}{c}.\vec{c}_0; \text{ b) } d\vec{P} = \frac{dW}{c}.\vec{c}_0; \vec{c}_0 = \frac{\vec{c}}{|\vec{c}|}; \tag{6.2-7}$$

and mass

$$\text{a) } m = \frac{W}{c^2}; \text{ b) } dm = \frac{dW}{c^2} \neq 0; \text{ c) } \vec{P} = m.\vec{c} = \frac{W}{c}.\vec{c}_0; \tag{6.2-8}$$

Here it should be borne in mind that the wave energy $W = m.c^2$ does not collide with the surface only at one moment, but during an interval of time $\Delta t > 0$, since it is a sum of n waves, with length λ and velocity c, i.e. there is length $l_w = n.\lambda$ and the collision at velocity c lasts for time $\Delta t = \frac{l_w}{c} = \frac{n\lambda}{c} = n.T$ i.e. for time $\Delta t = n.T$, where T is the period of one wave. That is why $\frac{dW}{dr} \neq 0$. And this fact also implies that $\frac{dm}{dt} \neq 0$.

Therefore, if we use the notation of the momentum of the electromagnetic waves (photons), it follows that

$$\vec{F} = \frac{d\vec{P}}{dt} = \frac{dm}{dt}.\vec{c} \neq 0, \tag{6.2-9}$$

since the energy, respectively the matter (the mass) of the wave, is not a point, but a length $l_w = n.\lambda$ ..

If (6.2-5) is multiplied by v_B^2 and v_C^2 and respectively divided by v_0^2 and c^2, we have

$$\text{a) } \frac{dW_B}{v_0^2} = \frac{1}{2}m_B.d\left(\frac{v^2}{v_0^2}\right) + \left(\frac{v^2}{v_0^2}\right).dm_B = dm_B; \text{ b) } dm_B = -\frac{1}{2}m_B.d\left(1 - \frac{v^2}{v_0^2}\right) + \left(\frac{v^2}{v_0^2}\right).dm_B \text{ and} \tag{6.2-10}$$

$$\text{a) } \frac{dW_C}{c^2} = m_C.d\left(\frac{v^2}{c^2}\right) + \left(\frac{v^2}{c^2}\right).dm_C = dm_C; \text{ b) } dm_C = -\frac{1}{2}m_C.d\left(1 - \frac{v^2}{c^2}\right) + \left(\frac{v^2}{c^2}\right).dm_C, \tag{6.2-11}$$

or if the differential equations (6.3-9) and (6.3-10) are processed, they obtain this form

$$\text{a) } \frac{dm_B}{m_B} = -\frac{1}{2}\frac{d\left(1 - \frac{v^2}{v_0^2}\right)}{1 - \frac{v^2}{v_0^2}} = -\frac{1}{2}.\frac{d\left(1 - \beta_0^2\right)}{1 - \beta_0^2}; \text{ b) } \frac{dm_C}{m_C} = -\frac{1}{2}\frac{d\left(1 - \frac{v^2}{c^2}\right)}{1 - \frac{v^2}{c^2}} = -\frac{1}{2}.\frac{d\left(1 - \beta_c^2\right)}{1 - \beta_c^2}. \tag{6.2-12}$$

The solutions to equation (6.2-12) with boundary conditions

$$\text{a) } v = 0 \rightarrow m = m_{0B} = m_0; \text{ b) } v \neq 0 \rightarrow m = m_B \neq m_{0B} = m_0 \text{ and} \tag{6.2-13}$$

$$\text{a) } v = 0 \rightarrow m = m_C = m_0; \text{ b) } v \neq 0 \rightarrow m = m_C \neq m_{0C} = m_0, \tag{6.2-14}$$

are respectively:

$$\text{a) } m_B = m_{0B}.\left(1 - \frac{v^2}{v_0^2}\right)^{-\frac{1}{2}}; \text{ b) } m_C = m_{0C}.\left(a - \frac{v^2}{c^2}\right)^{-\frac{1}{2}}. \tag{6.2-15}$$

If in (6.2-5) we take into account (6.2-14), then for the full energies we have

$$W_B = m_B.v_0^2 = m_{0B}.v_0^2.\left(1 - \frac{v^2}{v_0^2}\right)^{-\frac{1}{2}} = W_{0B}.\left(1 - \frac{v^2}{v_0^2}\right)^{-\frac{1}{2}} \text{ and} \tag{6.2-16}$$

$$W_C = m_C.c^2 = m_{0C}.c^2.\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}} = W_{0C}.\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}}, \tag{6.3-17}$$

whence at $v = 0$ we derive the regularities of the internal energies, which bodies have at rest

$$\text{a) } W_{0B} = m_{0B}.v_0^2; \text{ b) } W_{0B} = m_{0C}.c^2; \text{ c) } m_{0C} = \frac{W_{0C}}{c^2}; \text{ d) } m_{0B} = \frac{W_{0B}}{v_0^2} \tag{6.2-18}$$

Since the substantial form of matter can be converted into a field form, in a most general case, the indexes "B" and "C" can be dropped and (6.2-17) and (6.2-18) can be summarized in unitary regularities.

$$\text{a) } m = m_0.\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}}; \text{ b) } W = m_0.c^2.\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}}; \text{ c) } W = m.c^2, \tag{6.2-19}$$

these results are obtained only through Galileo's transformations, i.e. without using Lorentz transformations.

IN THIS WAY, WE HAVE SHOWN THAT (6.2-19) ARE CLASSICAL, NOT RELATIVISTIC LAWS, WHEREBY IT HAS ALSO BEEN POINTED OUT THAT EVEN IN CLASSICAL PHYSICS (ELECTROMAGNETISM), THE NOTION OF ELECTROMAGNETIC MATTER INTRODUCED BY MAXWELL WAS APPARENT, BUT NOT YET SUMMARIZED, AND MAXWELL'S NOTION OF ELECTROMAGNETIC MATTER WAS USED FOR THE ESSENCE OF THE ELECTROMAGNETIC FIELD.

6.3. ANALOGIES BETWEEN ELECTROMAGNETIC AND MECHANICAL WAVE PROCESSES

6.3.1. Electromagnetic wave processes

The photon, as the most elementary, in the sense of the most primary, field particle, out of which electromagnetic field is structured, which is the lowest level of structure of electromagnetic matter (field form), is also a particle, which appears as a wave or as a body – (in a wave aspect and respectively, in an aspect of a body) depending on the specific conditions. In general, the photon is a momentum of a series

of N electromagnetic waves with length $\lambda_C = \frac{c}{\nu_C}$ *and is emitted by an atom (molecule) for time*

$\tau \approx 10^{-8}$ s . *Because of this, the series of waves (with a wave length of λ_C , such as the photon itself)has a length of $l_f = N.\lambda_C = c.\tau = 3.10^8.10^{-8} = 3$ m . And the transverse section of the photon is about*

$D \approx 10^{-7}$ m . *In this sense, it (the photon) manifests itself depending on conditions, either as a body of length l_f or as a series of waves and therefore, it can be observed with an interferometer, and the photon has the electromagnetic wave energy of one photon.*

$$\text{a) } W_\nu = h.\nu; \text{ b) } W_\nu = m_\nu.c^2; \tag{6.3-1}$$

The momentum of the photon is

$$\text{a) } \vec{p}_\nu = \frac{W_\nu}{c}.\vec{c}_0 = \frac{h.\nu}{c}.\vec{c}_0; \text{ b) } \vec{p}_\nu = \frac{W_\nu}{c}.\vec{c}_0 = m_\nu.\vec{c}; \tag{6.3-2}$$

The mass (quantity of electromagnetic matter) of the photon is

$$\text{a) } m_\nu = \frac{h.\nu}{c^2}; \text{ b) } m_\nu = \frac{W_\nu}{c^2}; \tag{6.3-3}$$

where: h – Planck's constant; ν – frequency; c – the wave velocity of electromagnetic waves in vacuum (velocity of light in vacuum).

THE VELOCITY OF THE EMITTED ELECTROMAGNETIC WAVES IN VACUUM RELATIVE TO THE GENERATOR (TRANSMITTER), ACCIRDING TO FRESNEL OF 1818, DOES NOT DEPEND ON THE VELOCITY OF MOVEMENT OF THE TRANSMITTER (GENERATOR):

a) $c = \text{const.}$; b) $c = \dfrac{w_{EH}}{\rho_{EH}} = \dfrac{w_E}{\rho_E} = \dfrac{w_H}{\rho_H} \rightarrow \left[\dfrac{J}{kg}\right]^2 \rightarrow \left[\dfrac{m^2}{s^2}\right]^2$;   (6.3-4)

where: w_E and w_{EH} are the densities of energies of electromagnetic waves and of electric and magnetic fields; ρ_E, ρ_{EH} and ρ_H are the respective densities of their masses.

For the velocity of emission of electromagnetic waves (6.3-4) in vacuum, the same condition holds true, as it already was mentioned, that *velocity is always c and is constant relative to the generator (transmitter)*, i.e.

a) $c = \text{const.}$; b) $\dfrac{d c}{d t} = 0$;   (6.3-5)

regardless of the state (the velocity $\vec{v}_g$) of the generator (transmitter) of electromagnetic waves.

The energy density w_{EH} of electromagnetic waves is a sum of the respective densities w_E and w_H of the energies of its electric E and magnetic H fields:

$$w_{EH} = w_E + w_H;$$ (6.3-6)

The analogous relationship for the density of the mass of electromagnetic waves is

$$\rho_{EH} = \dfrac{w_{EH}}{c^2} = \dfrac{w_E}{c^2} + \dfrac{w_H}{c^2} = \rho_E + \rho_H;$$ (6.3-7)

The generator frequency of electromagnetic waves, and therefore of the photon is

$$v_g = \dfrac{c}{\lambda_g};$$ (6.3-8)

where: λ_g is the generator length (at the moment of emission) and v_g – the generator frequency of electromagnetic waves during emission, at velocity of propagation, which is always constant, according to (6.3-3), and equal to c.

6.3.2. Mechanical wave processes

The emission of mechanical waves takes place in elastic (mechanical) electromagnetic medium – matter, of a great variety in its levels structure, above this of the electromagnetic field. The elastic medium as electromagnetic matter is composed of structural elements, such as: electrons, protons, neutrons and photons. This implies that the properties, respectively parameters of mechanical waves, should be analogous to those of the waves of electromagnetic field.

The mechanical waves in electromagnetic matter are discussed on the following model.

Let there is a straight rod of firm elastic medium – electromagnetic matter, with cross-section S, length l, density of mass ρ_0 and modulus of elasticity E_0, and let a sinusoidal in time force acts upon its beginning, designated by A

a) $F = F_0 \sin\omega_0.t = k_F.v_0^2.\sin\omega_0.t$; b) $F_0 = k_F.v_0^2$; c) $k_F = \dfrac{F_0}{v_0^2} = \text{const.}$;   (6.3-9)

As a result of the mechanical tension

$$\sigma = \dfrac{F}{S};$$ (6.3-10)

mechanical deformation $æ_0$ appears at the beginning A of the rod as well as compactness of the density of the mass $\Delta\rho_0$ with amplitude

a) $æ_0 = \dfrac{\sigma_0}{E_0} = \dfrac{F_0}{S.E_0}$; b) $\Delta\rho_0 = æ_0.\rho_0$; c) $\sigma_0 = \dfrac{F_0}{S}$;   (6.3-11)

The compactness of the mass, of the matter of wave $\Delta\rho_0$, moves in the elastic medium at wave velocity v_0 in direction to the end of the rod along its length l. At distance r from the beginning, the sinusoidal relationship of $\Delta\rho$ is

$$\Delta\rho = æ_0.\rho_0.\sin\omega_0.\left(t - \dfrac{r}{v_0}\right) = \Delta\rho_0.\sin\omega_0.\left(t - \dfrac{r}{v_0}\right);$$ (6.3-12)

where: $F_0 = k_F.v_0^2$ is the amplitude value of the force. It is proportional to the square of the circular frequency $(\omega_0 = 2.\pi.v_0)$ of the mechanical wave process. Therefore F_0 is proportional to the square of the frequency v_0 by a constant physical coefficient k_F of dimensionality: force upon the square of the generator frequency

$$k_F = \frac{F_0}{v_0^2}, \tag{6.3-13}$$

at wave frequency v_0 of the mechanical wave process and wave length

$$\lambda_0 = \frac{v_0}{v_0}; \tag{6.3-14}$$

The wave velocity relative to the elastic medium is determined by the regularity, given by Newton

a) $v_0^2 = E_0.\rho_0^{-1} = \text{const.} \to \dfrac{\left[m^2\right]}{\left[s^2\right]}$; b) $E_0 \to \dfrac{[N]}{[m^2]} = \dfrac{[J]}{[m^3]} = w_0$; c) $\rho_0 \to \dfrac{[kg]}{[m^3]}$; $\qquad$ (6.3-15)

where: E_0 is Young modulus of elasticity; ρ_0 - mass density. And since $N \to \left[J.m^{-1}\right]$, and the Joule has a

dimensionality of $J = \dfrac{kg.m^2}{s^2}$

$$v_0^2 \to [\frac{J}{kg}] \to [\frac{m^2}{s^2}] = \frac{w}{\rho_0} = \frac{\text{energy density}}{\text{mass density}}; \tag{6.3-16}$$

The compactness of the mass (matter) of the wave of the deformation momentum – of the mass of the generator length λ_g of the mechanical wave is

a) $m_{\mathit{æ}\lambda_g} = \dfrac{\Delta\rho_0.S}{\pi}.\lambda_g = \dfrac{k_F.v_0^2.\rho_0}{\pi.E_0}.\dfrac{v_0}{v_0} = \dfrac{k_F.\rho_0}{\pi.E_0}.v_0.v = D.v_0 = \text{const}$; b) $D = \dfrac{k_F.\rho_0.v_0}{\pi.E_0} = \text{const.}$; $\qquad$ (6.3-17)

The mass of the wave $m_{\mathit{ae}\lambda_g}$ moves relative to the elastic medium only at the wave velocity v_0 (6.3-15) or they are mechanical waves in the elastic medium of electromagnetic matter. Analogously, as it is with the photon, this mass cannot exist at another velocity relative to the electromagnetic elastic medium, since (6.3-17) a implies that these relationships hold true for the velocity and momentum of a wave:

a) $v_0 = \text{const.}$; b) $\dfrac{dv_0}{dt} = 0$; c) $P_{\mathit{æ}\lambda_g}.v_0 = \text{const.}$; $\qquad$ (6.3-18)

i.e. if $\dfrac{dv_0}{dt} = 0$, the momentum $P_{ae} = m_{ae\lambda}.v_0$ of matter (mass) of the wave (respectively, the momentum of the wave), exists only at the value of velocity, equal to the wave velocity v_0 relative to the elastic medium. Therefore the force is

$$F = \frac{dP_{ae0}}{dt} = \frac{d(m_{ae\lambda}.v_0)}{dt} = v_0\frac{dm_{ae\lambda}}{dt} + 0 \neq 0; \tag{6.3-19}$$

since $\dfrac{dv}{dt} = 0$; $m_{ae\lambda} = D.v_0 = \text{const.} \neq 0$, i.e. the mass $m_{ae\lambda}$ exists only at $v = v_0 tW$. This is so because it is about the whole energy of n waves for time $\tau_n = n.T_0 \neq \text{const.}$, where $T_0 = \dfrac{1}{v}$ is the period of one wave.

Since the relationship (6.3-4) also holds true for the velocity of electromagnetic waves, the equations (6.3-17) and (6.3-18) hold true, too, then

$$\frac{dP_C}{dt} = \frac{d(m_v.c)}{dt} = c.\frac{dm_v}{dt} + 0 \neq 0; \tag{6.3-20}$$

because $\dfrac{dc}{dt} = 0$, and $m_v = \dfrac{h.v_0}{c^2} = \text{const.} \neq 0$.

The inference from (6.3-20) is that for a stationary observer B relative to their generators, both the mechanical and electromagnetic waves **can exist only at wave velocities** $v_0 = \text{const.}$ **and** $c = \text{const.}$ **, respectively.**

Since the mass of the mechanical wave $m_{ae\lambda_g} > 0$ always moves relative to a stationary observer in the elastic medium at velocity $v = \text{const.}$, its momentum

a) $\vec{P}_{\text{æ}0} = m_{\text{æ}\lambda}.\vec{v}_0 \neq \text{const.}$ at b) $m_{\text{æ}} \neq 0 \rightarrow$ and $\mathrm{d}\vec{F}_{Gi} = \vec{G}_{0i}.\mathrm{d}m_i = -\rho\dfrac{m_0.\gamma.\vec{r}.\mathrm{d}V_{i0}}{r_i^2};$ (6.3-21)

and its full derivative relative to time, according to (6.3-18) b is

$$\vec{F} = \frac{\mathrm{d}\vec{P}_{\text{æ}0}}{\mathrm{d}t} = \frac{\mathrm{d}\left(m_{\text{æ}\lambda}.\vec{v}_0\right)}{\mathrm{d}t} = \vec{v}_0.\frac{\mathrm{d}m_{\text{æ}\lambda}}{\mathrm{d}t} + 0 = \vec{v}.\frac{\mathrm{d}m_{\text{æ}\lambda}}{\mathrm{d}t};$$ (6.3-22)

and the force, which corresponds to this derivative is

$$\vec{F}_{\text{æ}\lambda} = \frac{\mathrm{d}\vec{P}_{\text{æ}\lambda}}{\mathrm{d}t} = \vec{v}_0.\frac{\mathrm{d}m_{\text{æ}\lambda}}{\mathrm{d}t}, \text{ since } \frac{\mathrm{d}\vec{v}_0}{\mathrm{d}t} = 0;$$ (6.3-23)

The energy, which corresponds to this force for one generator length $\lambda_g > 0$, of the wave generated by this force $\vec{F}_{ae\lambda}$ is equal to the work A by the pathway $l = \lambda$ and is

$$\mathrm{d}A_\lambda = dW_\lambda = \vec{F}_{\text{æ}\lambda}\lambda_g;$$ (6.3-24)

and the differential of the energy $W_{ae\lambda}$ under the condition (6.3-36) b is

$$\mathrm{d}W_{\text{æ}\lambda} = v_0^2.\mathrm{d}m_{\text{æ}\lambda};$$ (6.3-25)

Then the mean density of the wave energy w_0, expressed by the mean density of the compactness of the mass $\rho_{ae\lambda} = \dfrac{\Delta\rho}{\pi}$, by using (6.3-25) is:

$$\text{a) } w_0 = \rho_{\text{æ}\lambda}.v_0^2, \text{ or b) } v_0^2 = \frac{w_0}{\rho_{\text{æ}\lambda}} = \frac{E_0}{\rho_0} = \frac{W_{\text{æ}\lambda}}{m_{\text{æ}\lambda}};$$ (6.3-26)

where: $W_{\text{æ}\lambda}$ is the energy of the wave; w_0 – the energy of the wave in a unit of a volume-density of the energy of the wave, $m_{ae\lambda}$ – matter (mass) of the wave; ρ_0 - mass density of the medium.

From the presented so far, by proceeding from the correspondence between the quantities of electromagnetic waves and of the mechanical waves in electromagnetic matter (the elastic electromagnetic medium), etc., we obtain the following analogies:

6.3.2.1. Emission by atoms of substance at deformation

The electromagnetic forces of cohesion between atoms (molecules) of substance are given as derivatives of Lenard-Jones potential. A significantly simplified model is considered of the forces of cohesion as forces between the electron in an atom and the nucleus of the atom, where in normal state of r and r_0, and at deformation æ the distance $r_\varepsilon = r_0\left(1 \pm \varepsilon\right)$. At these distances, force F_ε and energy W_ε are

a) $F_\varepsilon = \dfrac{q_e^2}{4.\pi.\varepsilon_0.r_0^2.\left(1 \pm \text{æ}\right)^2}$; b) $W_\varepsilon = \dfrac{q_e^2}{4.\pi.\varepsilon_0.r_0.\left(1 \pm \text{æ}\right)}$; (6.3-28)

In the process of deformation the atom emits energy

$$W_{\varepsilon f\varepsilon} \approx \frac{q_e^2.\left(1 \mp \text{æ}\right)^2.a^2}{c^3};$$ (6.3-29)

The thermal energy released during mechanical treatment of bodies in the form of photons, according to literature is proportional to $W_{\varepsilon f}$ (6.3-29) inside and outside the substance and it heats the substance, as it is in thermal emission according to Max Planck.

Energy losses and heating of rubbing surfaces should be treated similarly. Because the surfaces have roughnesses of the order of the size of a few molecules, then at friction, part of these roughnesses get deformed or cut off. For a process of a qualitative model like this one, it is possible to explain qualitatively energy losses or heat released during friction.

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Emphasis.

EVERY MECHANICAL FORCE INTERACTION ON A SUBSTANCE (PUSH, PULL, BENDING, TWISTING, AND LIQUIDS MOVING – STIRRING OR FLOWING) RESULTS IN DEFORMATION OF THE ORBITALS OF ELECTRONS IN ITS ATOMS (MOLECULES) WHICH RESULTS IN PHOTON EMISSION (THERMAL ENERGY).

Due to these mechanical processes inside or on the surface of a substance, inside or outside of it, photons (electromagnetic waves) are emitted. Their quantity (the density) depends on:
- 1. the size of deformations of the orbitals;
- 2. the number of deformed atoms (molecules);
- 3. the kind of substance: a solid body or liquid;
- 4. the temperature of the substance.

6.3.2.2. Oscillating current frame of capacity C_0 and inductivity L_0

The wave equation of an oscillating current frame of capacity $C_0 \pm 0$, inductivity $L_0 \neq 0$ and resistance $R = 0$ is

$$\frac{d^2 Q}{dt^2} + \frac{1}{L_0.C_0}.Q = \frac{d^2 Q}{dt^2} + \omega_0^2.Q = 0 ; \qquad (6.3\text{-}30)$$

Where: the electric charge Q of C_0 and the angular frequency ω_0 are

a) $Q = Q_0.\sin(\omega_0.t + y_0)$; b) $\omega_0 = \dfrac{1}{L_0.C_0} = 4\pi^2 v_0^2$; c) $v_0^2 = \left(4\pi^2 L_0.C_0\right)^{-1}$; $\qquad (6.3\text{-}31)$

The current i and the voltage are

a) $i = \dfrac{dQ}{dt} = i_0.\omega \dfrac{L_0.i_0^2}{2}$; b) $i_0 = Q_0.\omega_0$; c) $U = -L_0.\dfrac{di}{dt} = \dfrac{Q}{C_0}$; $\qquad (6.3\text{-}32)$

The full energy circulating within the frame is $W_0 = W_E = W_L$, i. e.

$$W_0 = \frac{Q_0^2}{2.C_0} = \frac{L_0 i_0^2}{2} = \frac{L_0.\omega_0^2.Q_0^2}{2} ; \qquad (6.3\text{-}33)$$

On condition that the length of frame l_0 is much shorter than the length of wave λ_0, i. e.

$l_0 << \lambda_0 = \dfrac{c}{v_0}$;

The energy of one wave of length λ_0 is

a) $W_\lambda = W_0.\lambda_0.2.L_0.\pi^2.Q_0^2.v_0 = H_\lambda.v_0$; b) $H_\lambda = 2.L_0.\pi^2.Q_0.c = \text{const.}$; $\qquad (6.3\text{-}34)$

where: c is the velocity of propagation of the electromagnetic energy in the frame l_0 .

For time $\tau = n.T_0$ or distance $r = n\lambda_0$ the wave energy

a) $W_n = n.W_\lambda = H_n.v_0$; b) $H_n = n.H_\lambda$; $\qquad (6.3\text{-}35)$

6.3.2.3. When electrons pass through very narrow channels

First, when electrons pass through very narrow channels of radius $R \ll 10^{-3}$ m *they pass first from an area of dielectric constant* ε_0 *of the air, whose value is almost equal to that of vacuum, toward the area of the very narrow channel, where the dielectric constant in channel is* $\varepsilon_k > \varepsilon_0$ *a, because of the strong influence of the atoms of the substance.* **Second,** *the electrons pass from an area, where there is a chaotic density of photon gas, which is emitted by the walls of the channel into the volume of the channel, where there are atoms on all sides of the channel, and these atoms emit photons toward the center of the channel. And* **third,** *inside the channel, from its walls, there is force of cohesion* $\vec{F}_c$, *which attracts the electron to the channel walls, since this force attracts the molecules of the substance, and the electron is a substantial form of electromagnetic energy.* **These three situations determine also three effects, as follows:**

A. In entering a channel for a very short time dt, or along a very small spatial interval $d\vec{r} = \vec{v}_0.dt$, the dielectric constant changes from ε_0 to $\varepsilon > \varepsilon_0$. Because of this fact the surrounding electric field changes significantly as well, as follows

$$\frac{dE}{dt} = -\frac{q_e}{4\pi\varepsilon^2 r^2}\cdot\frac{d\varepsilon}{dt} = -q_e\frac{A}{\varepsilon^2}\cdot\frac{d\varepsilon}{dt}\,;\; A = \left(4.\pi.\varepsilon.r^2\right)^{-1}\,;$$ (6.3-36)

In this change of the electric field, according to Maxwell, its magnetic field $\vec{H} = \varepsilon.\left[\vec{v}.\vec{E}\right]$ changes too, so that a system is formed which describes, say, a flat electromagnetic wave

$$\text{a)}\; \frac{d^2 E}{dt^2} = c^2.\frac{d^2 E}{dx^2}\,;\; \text{b)}\; \frac{d^2 H}{dt^2} = c^2.\frac{d^2 H}{dx^2}\,;\; c^2 = \left(\varepsilon\mu\right)^{-1}\,;$$ (6.3-37)

This process with the electron is manifested in reverse direction as well, from $\varepsilon > \varepsilon_0$ to $\varepsilon = \varepsilon_0$ on exiting the channel and therefore, depending on the radius of the channel and the kind of substance and velocity of the electron, it may not be an electron at velocity $v_e \ll c$ that exits from the channel, but a photon with energy and frequency

$$\text{a)}\; W_f = m_{e0}.c^2 = h.\nu_0\,;\; \text{b)}\; \nu_0 = \frac{m_{e0}.c^2}{h}\,;$$ (6.3-38)

B. *The walls of the channel emit photons, which exert force action upon the electrons, when they are in the channel. These effects influence the state and the velocity of the electrons, which are in the channel, in two directions:*
a) upon the direction of the velocity of the electron on its exiting the channel;
b) very slightly, upon the possibility for the electron to be transformed into a photon at the exit of the channel.

C. Because the channel in the substance has a very small radius $R \lll 10^{-3}$ m, and the electron can rarely hit the center of the channel, but usually passes closer to one of the walls of the channel, and that is why it is attracted more heavily toward the wall by the force of cohesion F_c, **so that this force declines it on its exiting the channel toward the wall and it declines, and does not fall upon the screen in a point opposite the channel, but aside.** Naturally, this is a real fact, if the electron does not convert into a photon after the channel.

Note

Regardless of the stationary or seemingly static state of the system of atoms (molecules) and the environment, the atoms in gases, liquids or solid bodies always emit and absorb photons, which explains why there is always a background of photon gas around atoms and molecules.

6.3.2.4. Commentary

The above theoretical inferences, with the exception of de Broglie's waves, have been experimentally validated. These facts, as a summary, should be interpreted as a logical physical principle, which states:

THE ENERGIES OF ALL WAVE AND OSCILLATING PROCESSES FOR A CERTAIN FINITE INTERVCAL OF TIME ARE EQUAL TO THE PRODUCT OF ONE CONSTANT AND THE FREQUENCY OF THE PROCESS.

This principle is a universal model, regardless of the consequences which it imposes on the development of physics.

This interpretation was first given by Paul Ehrenfest[*] in 1914 as a proof that the formula of energy of a photon $W = h.\nu$ is not unique. But experts on quantum mechanics do not take into consideration this fact which rejects the uniqueness of the formula of photon energy, as well as the contention about Heisenberg inequality in quantum mechanics, which inequality is based on photon energy, but it is in its structure a universal formula about the energies of all wave processes both for substantial and field forms of electromagnetic matter and it has this form

$$W = H.\nu;$$ (6.3-39)

where the constant H does not depend on the structure of the transmitter.

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[*] In A. M. Khazen's book. "Pole, volni, chastitsi ih modeli" (Field, waves, particles, their models", publ."Prosveshtenie" Moscow, 1979, Chapter 5, paragraph 2 "Mayatnik Erenfesta" (Ehrenfest's Pendulum)", p. 78.

CHAPTER SEVEN
GRAVITATION OF OBJECTS
WITH A VOLUME GREATER THAN ZERO

7.1. GENERAL FORMULATIONS

When analyzing all substantial objects with volumes different from zero, when discussing the topic of gravitation, it will be useful to cite the theorem of the gravitational field outside the volume of a spherical body as proved by Isaac Newton in 1686 (a year before "Principles…"), which states: **"A spherical body of a homogenous density of the mass (matter)** $\rho_m = $ const. **and radius** $R > 0$ **and volume** $V > 0$ **generates in the space outside its volume, such a gravitational field as it would be if the gravitational field were generated by its the mass** m_0, **if it were concentrated in a point, which were placed in the center of the sphere."** THIS CITATION OF NEWTON IS A PROOF THAT THE NOTION OF MASS IS AN ABSTRACTED NOTION OF THE NOTION OF QUANTITY OF MATTER RATHER THAN A PROPERTY OF MATTER.

It follows as an inference from the above theorem that the radius in the nominator of the formulae of the gravitational field (7.1-1) and force (7.2-8) is of power two 2 (r^{-2}) only when the mass m_0 is with a volume $V = 0$, i.e. it is a dimensionless point (the body has a volume equal to zero).

When computing the gravitational fields and forces of bodies with a volume larger than zero, what all real bodies are, which are electromagnetic matter, we have to integrate for each point of the volume, whereby the mass of this elementary volume of the body is $dm_e = \rho.dV_i$, the distance is r_i; moreover, the gravitational field G_i relative to the attracting body, which is at distance r_i, is also the force of attraction F_i of a body with a spherical mass m

$$\text{a) } \vec{G}_{0i} = -\frac{m_0.\gamma}{r_i^2}.\vec{r}_0; \text{ b) } d\vec{F}_{Gi} = \vec{G}_{0i}.dm_i = -\rho\frac{dV_i.m_0.\gamma.\vec{r}_0}{r_i^2}; \tag{7.1-1}$$

where: γ is the gravitational constant.

It follows that the gravitational force between two ideally spherical bodies A and B with homogenous density of their masses are $\rho_A = \rho_B = \rho = $ const., masses $m_A > 0$, $m_B > 0$ spherical volumes $V_A > 0$, $V_B > 0$ and radiuses $r_A > 0$, $r_B > 0$ at a distance between their centers $OO' = H$ (according to Fig. 7.3.2) and with a coordinate system in the center of the body (the sphere) B, *in order to derive the force of attraction between the bodies A and B according to Newton's theorem, it is assumes that the body A is reduced at point O (Fig. 7.3.2) and the formula (7.1-1)b is applied for the force* $dF_{AB} = dF_i$ *between body A (point O) and the elementary volumes* $dV = dx.dy.dz$ *of body B and is integrated for the volume of the body B with radius* r_B. Under these conditions for the gravitational force between bodies **A** and **B**, where when integrating, the radius r_i is a variable quantity, we have the precise value of the gravitation force.

7.2. GRAVITATION OF BODIES WITH VOLUME V LARGER THAN ZERO

Gravitational filed is **a genetic product of electromagnetic matter** *(of primary electromagnetic fields, which are electrostatic and magnetic)* and because of this **the nature of gravitational field is electromagnetic – i.e. it is a secondary electromagnetic field and is carried by a specific structure of electromagnetic matter, called gravitational. It is generated by electromagnetic matter both in a substantial and in a field form in the form of the densities of the electric and magnetic fields, which also generate gravitational fields.**

THE PRESENTED ABOVE ABOUT ELECTROMAGNETIC AND GRAVITATIONAL FIELDS IMPLIES THAT THEY ARE GENETICALLY UNITARY AS WELL AS INSEPARABLY BOUND TO EACH OTHER IN TIME AND SPACE, I.E. NEITHER OF THEM CAN EXIST INDEPENDENTLY, WITHOUT BEING BOUND TO THE OTHER. *This statement-law is based on a sufficient number of experimental facts.*

7.2.1. Electromagnetic masses and energies of electrons

A) At rest $(v \approx 0; v \ll c)$ the electron mass and energy are

$$\text{a) } m_{e0} = q_e^2.k_m; \text{ b) } W_{e0} = m_{e0}.c^2 = q_e^2.k_m.c^2; \quad k_m = \left(4.\pi.\varepsilon_0.r_{e0}.c^2\right)^{-1}; \tag{7.2-1}$$

B) At velocity $v < c$ they are

$$\text{a) } m_e = m_{e0}\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}}; \text{ b) } W_e = W_{e0}\left[\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}} - 1\right]; \tag{7.2-2}$$

7.2.2 Gravitation of electrons at velocity $v \ll c$

A) The gravitational potential of an electron

$$U_G = \frac{m_{e0}.\gamma}{r}; \tag{7.2-3}$$

B) Gravitational field: a secondary electromagnetic field
where: γ is the gravitational constant.

$$\vec{G}_G = \frac{\vec{r}_0.\mathrm{d}U_G}{\mathrm{d}r} = -\frac{m_{e0}.\gamma}{r^2}.\vec{r}_0; \tag{7.2-4}$$

C) Density of gravitational energy

$$w_G = \frac{G^2}{2\gamma} = \frac{m_{e0}^2.\gamma^2}{r^4} = \frac{q^4.k_m^2.\gamma}{r^4} > 0; \tag{7.2-5}$$

D) The gravitational energy and mass of the electron are

$$\text{a) } W_{eG} = \int_{r_{e0}}^{\infty} w_G.\mathrm{d}V = \frac{m_{e0}^2.\gamma}{r_{e0}} = \frac{q_e^4.k_m^2.\gamma}{r_{e0}}; \text{ b) } m_{eG} = \frac{W_{eG}}{c^2}; \tag{7.2-6}$$

E) *The gravitational charge is the mass of the electron: $q_G = m_{e0}$;* $\tag{7.2-7}$
F) Gravitational force is

$$\vec{F}_{eG} = m_{e0}.\vec{G}_e = -\frac{m_{e0}^2.\gamma.\vec{r}_0}{r^2} = -\frac{q_e^4.k_m^2.\gamma}{r^2}.\vec{r}_0; \tag{7.2-8}$$

G) The relationship between W_{e0} and W_{eG} or m_{e0} and m_{eG} is

$$k_{eG} = \frac{W_{e0}}{W_{eG}} = \frac{m_{e0}}{m_{eG}} \approx 4{,}17.10^{42}; \tag{7.2-9}$$

H) The presented above motivates the unity between the Coulomb's law and Newton' gravitation for two electrons with charges $q_{e1} = q_{ei} = q_e$

$$\text{a) } \vec{F}_e = \frac{q_{ei}.q_{ei}.\vec{r}_0}{4.\pi.\varepsilon_0.r^2} - \frac{q_{e1}^2.q_{e2}^2.k_m^2.\gamma.\vec{r}_0}{r^2} = \vec{F}_{eq} + \vec{F}_{eG}; \text{ b) } \left|\vec{F}_{eq}\right| \gg \left|\vec{F}_{eG}\right|; \tag{7.2-10}$$

In the equations for the gravitation of the electrons, we should emphasize the fact that the electrons have a very small radius, $r_{e0} \approx 2{,}81.10^{-15}$ m, and hence, a very small volume. Therefore, they are practically almost without any volume relative to the macro bodies whose dimensions (volumes) are much larger than them. *In this sense, the gravitational interactions between the electrons are practically between point-like (V = 0) objects. That is why the value of the power of the distance r in the nominator of the formula of the gravitational field and force of bodies with volume V = 0 is r^2. That was Newton's idea, since he used the notion of mass as a point-like object, placed in the center of gravity of the object to which the mass (the quantity of matter) belongs.* In this case it is assumed that the mass is only with its inertial and gravitational property of the object whose mass it is.
I. e. the above general formulae are for point-like objects a volume

$$V = 0; \tag{7.2-11}$$

For the purposes of the analysis, some notions should also be specified, such as:

7.3. GRAVITATIONAL FIELDS AND FORCES

7.3.1. Gravitational fields and forces

Here we should point out that about a century ago it was a well-known scientific fact that **electrons generate also a gravitational field**, i.e. that **electric charge generates a gravitational field, too.** But physicists have not paid due attention to this scientific fact which has a crucial role for the theory of gravitation. **AND IT IS EXACTLY THIS FACT THAT IS THE EMBRYO FOR THE DEVELOPMENT OF THE THEORY OF GRAVITATION.**

7.3.2. Gravitational fields, energies, masses and forces of electrons

Since it is generally accepted that electrons (electron e^- and positron e^+) are models for studying the properties (manifestations) of objects of the unitary electromagnetic matter of nature; therefore, when studying the gravitational property of electromagnetic matter, we also start from the electrons.

7.3.2.1. General formulations

According to Newton, all natural objects have the attributive property of attraction, i.e. they have a gravitational property.

The force of attraction is proportional to the product of masses (quantities of matter) of objects 1 and 2 with masses m_1 and m_2, and of the gravitational constant γ, and inversely proportional to the square at the distance (r^2) between objects (masses).

The sign is minus (-) since it is accepted in physics that the forces of attraction should be seen as negative and designated by the minus sign.

The gravitational force of attraction, according to Isaac Newton, is between the masses of the bodies, which attract each other and which have volume V = 0, i.e. they are in the form of a dimensionless point, and the same is assumed for the quantities of matter of electrons m_{01} and m_{02}, whereby the gravitational force between them at distance r between them is

$$\vec{F}_G = -\frac{m_{01}.m_{02}.\gamma}{r^2}.\vec{r}_0; \;\; \vec{r}_0 = \frac{\vec{r}}{|\vec{r}|}; \tag{7.3-1}$$

Later, after Newton, with the introduction of the notion of physical fields, the notion of gravitational field $\vec{G}$ was also introduced, and force $\vec{F}_G$ was also written by means of the notion of gravitational field $\vec{G}$.

$$\text{a) } \vec{F}_G = m_{01}.\vec{G}_2; \;\; \text{b) } \vec{G}_2 = -\frac{m_{02}.\gamma.\vec{r}_0}{r^2}; \tag{7.3-2}$$

where: $\vec{G}_2$ is the gravitational field, generated by mass m_{02}.

In this definition, mass m_{02}, which generates a gravitational field, is a gravitational charge q_G, analogously to the formula of electric field $\vec{E}$, which is generated by electric charge q_e

$$\vec{E} = \frac{q_e.\vec{r}_0}{4.\pi.\varepsilon_0.r^2} = \frac{q_e.k_e.\vec{r}_0}{r^2}, \;\; k_e = (4.\pi.\varepsilon_0)^{-1}; \tag{7.3-3}$$

Therefore, the mass in the formula of the gravitational field is (means) a gravitational charge.

Since electrons are a substantial form of the unitary electromagnetic matter of nature and they also generate gravitational fields, energies and forces, i.e. the masses of electrons are also gravitational charges. In this case, electrons are the carrier and generator of gravitational fields, energies, masses and force, and electrons are elementary particles of electromagnetic matter. This fact implies, according to the genetic principle, that gravitational phenomena (quantities) and as a product (result) of the electromagnetic matter have also electromagnetic essence.

The gravitational fields of the mass m_{e0} of the electron have densities of masses of electrostatic field ρ_E and magnetic field ρ_H, as follows

$$\text{a) } G_{m_{e0}} \equiv m_{e0} = q_e^2.k_m; \;\; \text{b) } G_{\rho_E} \equiv \rho_E = \frac{\varepsilon_0.E^2}{2.c^2}; \;\; \text{c) } G_{\rho_H} \equiv \rho_H = \frac{\mu_0.H^2}{2.c^2}; \tag{7.3-4}$$

i.e. they are proportional to the squares of a) electric charge q_e^2; b) to the squares of electric filed E^2 and magnetic field H^2.

This circumstance means that the gravitational fields are square electromagnetic fields. However, on the other hand, since it has been assumed that the electrical E and the magnetic H fields are electromagnetic fields in the aspect of primary electromagnetic fields whose densities of masses generate gravitational fields, then it follows that gravitational fields are secondary electromagnetic fields, which are a second product of the quantities, associated with electric charges, and this is the motivation to call them secondary electromagnetic fields or unipolar electromagnetic fields. ***The assumption that they are unipolar is motivated by the fact that they are proportional to the squares of their defining quantities***

$$\text{a) } \left(\pm q_e\right)^2 > 0; \text{ b) } \left(\pm E\right)^2 > 0; \text{ c) } \left(\pm H\right)^2 > 0; \tag{7.3-5}$$

which are only positive, due to which they determine the unipolarity of gravitational fields. And since the fields generate forces, then these forces are also unipolar (only of attraction).

I.e. the electromagnetic essence of the gravitational fields as a function of the squares of the electromagnetic quantities q_e^2, E^2 and H^2, determines the unipolarity of gravitational fields and forces. Moreover, electromagnetic energy W_{EM} of objects generates gravitational fields and forces via its mass

$$\text{a) } m_{EH} = \frac{W_{EH}}{c^2} > 0; \text{ b) } \vec{G}_{EH} = -\frac{m_{EH}}{r^2} \cdot \gamma \cdot \vec{r}_0 < 0; \tag{7.3-6}$$

Emphasis

Here it should be pointed out that the notation r^{-2} holds true only approximately, only when the dimensions of the quantities of matter m_1 and m_2, in a most general case (for instance) when their dimensions ℓ_1 and ℓ_2 (equal to the radiuses of the respective bodies $\ell_1 = R_1$ and $\ell^2 = R^2$) are much smaller than the distance r between them

$$\text{a) } \ell_1 = R_1 <<< r; \text{ b) } \ell_2 = R_2 <<< r; \tag{7.3-7}$$

That is exactly the condition (requirement) that Newton sets in "Principles..." so that power -2 of $r \to r^{-2}$ should hold true.

If the condition (7.3-7) is not met, then the exponent will not be 2, but $2 \pm \alpha \neq 2$

$$\left(0 < \alpha \ll 1\right); \tag{7.3-8}$$

Or the force $\vec{F}_G$ from (7.1-1 b) holds true only for the individual points with densities of masses ρ than the quantity of matter Q of a body with mass m_0 and a real volume $V > 0$, which (the mass density ρ) is an abstracted notion of a material object (material point) with quantity of matter Q and volume V > 0.

7.3.2.2. When the electron is at rest ($v_e = 0$)

The mass of the electron $m_{e0} = q_e^2 \cdot k_m$ generates gravitational field

$$\vec{G}_{e0} = -\frac{m_{e0} \cdot \gamma}{r^2} \cdot \vec{r}_0 = -\frac{q_e^2 \cdot k_m \cdot \gamma \cdot \vec{r}_0}{r^2}; \tag{7.3-9}$$

where: γ is the gravitational constant; q_e - electric charge $q_e = 1,6.10^{-19}$ C of the electron.

Since, in general, the electric charge is quantized (its value is $Q_e = n.q_e$, where n = 1, 2, 3... etc., and q_e is the minimal possible value (quantum) of the quantity of electric charge), in this aspect it can be said that $\vec{G}_{e0}$ is quantized, too.

The densities of the energy w_{Ge0} and of the mass ρ_{Ge0} of the gravitational fields are

$$\text{a) } w_{Ge0} = \frac{G_{e0}^2}{2.\gamma}; \text{ b) } \rho_{Ge0} = \frac{w_{Ge0}}{c^2}; \tag{7.3-10}$$

The full gravitational energy of the electron at $v = 0$ is

$$\text{a) } W_{Ge0} = \int_{r_{e0}}^{\infty} w_{Ge0} . dV = q_e^4 . k_{G0}; \text{ b) } k_{G0} = \gamma . \left(24.\pi.\varepsilon_e^2 . r_e^2 . c^4\right)^{-1}; \tag{7.3-11}$$

The gravitational mass of the electron at $v = 0$ is

$$m_{Ge0} = \frac{W_{Ge0}}{c^2} = \frac{q_e^4}{c^2}.k_{G0};$$ (7.3-12)

It is evident from (7.3-11) and (7.3-12) *that in its essence (nature) the gravitational field is generated by electric charge q_e raised to even power, which is always a positive quantity $q_e^{2.n} > 0$. That is the explanation why the gravitational field is unipolar*.

The relationship between the electrostatic energies W_{e0} and masses m_{e0} of the electron and its gravitational energies W_{Ge01} and masses m_{Ge01} are

$$\frac{W_{e0}}{W_{Ge0}} = \frac{m_{e0}}{m_{Ge0}} \approx 4{,}17.10^{42};$$ (7.3-13)

At velocity $v \ll c$, magnetic field $H = \varepsilon_0.\left[\vec{v}.\vec{E}\right]$, magnetic energy $W_H = \frac{m_{e0}.v^2}{2}$ and mass $m_{He} = \frac{W_H}{c^2}$, are generated around the electron, and to that mass corresponds gravitational field

$$\vec{G}_{He} = -\frac{m_{He}.\gamma}{r^2}\vec{r}_0;$$

7.3.2.3. Gravitational field of electromagnetic waves

The energy W_{EH} and the mass m_{EH} of sinusoid electromagnetic waves are pulsating in the time at a frequency twice as high as the frequency of electromagnetic waves

a) $W_{EH} = W_{EH0}.\sin^2 \omega.t = W_{EH0}.\frac{(1 - \cos 2\omega t)}{2} = \frac{W_{EH0}}{2} - \frac{W_{EH0}}{2}.\cos^2 2\omega.t \geq 0;$

b) $m_{EH} = m_{EH0}.\sin^2 \omega.t = m_{EH0}.\frac{(1 - \cos 2\omega.t)}{2} = \frac{m_{EH0}}{2} - \frac{m_{EH0}}{2}.\cos 2\omega.t \geq 0;$ (7.3-14)

where: W_{EH0} and m_{EH0} are amplitudes of the energy and the mass.

The density of the mass of the electromagnetic wave is sum of the densities of the masses ρ_E and ρ_H of the electric field $\vec{E}$ and of the magnetic field $\vec{H}$

$$\rho_{EH} = \rho_E + \rho_H = \frac{\varepsilon_0.E^2}{2.c^2} + \frac{\mu_0.H^2}{2.c^2};$$ (7.3-15)

to which correspond gravitational fields

$$\vec{G}_{\rho EH} = \vec{G}_{\rho E} + \vec{G}_{\rho H} = -\frac{\rho_E.\gamma.\vec{r}_0}{r^2} - \frac{\rho_H.\gamma.\vec{r}_0}{r^2} = -\frac{\rho_{EH}.\gamma.\vec{r}_0}{r^2};$$ (7.3-16)

which are also pulsating $\left[\sin^2 \omega.t = \frac{1}{2}(1 - \cos 2\omega.t)\right]$.

The mean mass of one wave for time $T_0 = \frac{1}{v}$ or for the length of one wave $\lambda = \frac{c}{v}$ is

$$\tau_{men} = \frac{W_{EH}}{\lambda.c^2};$$ (7.3-17)

It follows from (7.3-17) that the gravitational field of electromagnetic waves is the field of mass in the form of a rod whose diameter D_v of the cross-section S_v of the wave is much smaller than the length $\lambda = n.\lambda_v$ of a flux of n waves, i. e. $l_v \gg D_v$, since according to paragraph 6.3.1. the length of a photon is about $l_f = 3$ m, and its cross-section has a diameter $D \approx 10^{-7}$ m is

$$\vec{G}_0 = \vec{G}_{\tau en} = -\frac{\tau_{men}.\gamma}{2.r}.\vec{r}_0 = \vec{G}_{v0} - \vec{G}_{v0}.\cos 2\omega.t \geq 0;$$ (7.3-18)

where:

$$G_{v0} = -\frac{\tau_{men}\cdot\gamma}{2.r};$$
(7.3-19)

is the amplitudinal value of the gravitational field, which corresponds to the mean value of the mass of the electromagnetic field of the wave, which is in the form of a filament.

It is evident from (7.3-18) that the gravitational field of the electromagnetic waves *is unipolar and pulsating.*

IN THIS SENSE, IF IT IS DESCRIBED RELATIVE TO AN AXIS OF TIME, WHICH IS AT A POSITIVE DISTANCE FROM $E \to \Delta E = \dfrac{E_0}{2}$ *AND FROM* $H \to \Delta H = \dfrac{H_0}{2}$, *RESPECTIVELY ABOVE THE AXIS, IT CAN BE TREATED AS A SINUSOID GRAVITATIONAL WAVE*, *WHICH IS INSEPARABLE FROM THE ELECTROMAGNETIC WAVE AND MOVES AT ITS VELOCITY.*

IN THIS SENSE, THE CLAIM IN THE THEORY OF RELATIVITY THAT THERE ARE INDEPENDENT GRAVITATIONAL WAVES LACKS MOTIVATION AND IS INCORRECT, MOREOVER, IT HAS NOT BEEN DIRECTLY VALIDATED EXPERIMENTALLY UP TO THIS PRESENT DAY.

Because of their linear mass τ_{men} (7.3-17) of electromagnetic waves, they generate gravitational fields (7.3-18) and enter into force interactions with other gravitational fields. This is the explanation why a beam of light from a remote star is attracted by the sun; however, the gravitational mass of the wave is not point-like, as it was used several times by Soldermann (1801) and Einstein (1911) when calculating the aberration of a sun beam by the sun, therefore, their calculations are incorrect, for the photon of the light beam the mass has length $\ell_C = \tau.c = 10^{-8}.3.10^8 = 3$ m and diameter of its cross-section $D \approx 10^{-7}$ m.

S. Poisson's equations hold true for the gravitational field, GF:
$$\text{a) } \mathrm{rot}\vec{G} = 0; \text{ b) } \mathrm{div}\vec{G} = -\rho_m.4.\pi.\gamma,$$
(7.3-20)

where:
$$\rho_m = \rho_{EH} = \rho_E + \rho_H = \frac{\varepsilon_0\left(\pm E\right)^2}{2.c^2} + \frac{\mu_0\left(\pm H\right)^2}{2.c^2} > 0;$$
(7.3-21)

is density of the electromagnetic matter, of the electromagnetic waves, of the electromagnetic field.

(7.3-20) and (7.3-21) imply these inferences which result from scientific facts:

First. Gravitational field is created (generated) by electromagnetic matter in a substantial or field form. It is a secondary electromagnetic field.

Second. Gravitational field is inextricably bound with (inseparable from) its carrier and generator – electromagnetic matter in a field or substantial form.

Third. Gravitational field has no eddy component due to the circumstance that it is proportional to the square of electromagnetic field, which is bipolar, but its square is always a positive quantity – a unipolar quantity, owing to which fact gravitational field is also only unipolar:

$$\text{a) } \vec{G}_E = -\frac{\varepsilon_0\left(\pm E\right)^2.\gamma}{2.c^2}.\frac{\vec{r}_0}{r^2} < 0 \text{ ; b) } \vec{G}_H = -\frac{\mu_0\left(\pm H\right)^2.\gamma}{2.c^2}.\frac{\vec{r}_0}{r^2} < 0; \text{ c) } \vec{G} = \vec{G}_E + \vec{G}_H < 0.$$
(7.3-22)

If we just imagine that there are gravitational waves, then their wave equation should be written in this form:
$$\frac{\partial^2 G}{\partial t^2} = v_G^2.\frac{\partial^2 G}{\partial r^2};$$
(7.3-23)

where: v_G is the velocity of the gravitational waves. *Up to the present moment, this velocity is not known as an independent velocity, except for what Einstein postulated, that it is equal to the velocity of light, OF WHICH NO EXPERIMENTAL CONFIRMATION EXISTS, NOR IS THERE ANY EXPERIMENTAL CONFIRMATION THAT INDEPENDENT GRAVITATIONAL WAVES EXIST, WHICH ARE SEPARABLE FROM THE ELECTROMAGNETIC WAVES THAT GENERATE THEM.*

In a most general case, the solution to (7.3-23) has this form:
$$\vec{G}\left(r,t\right) = \vec{G}_{01}.\cos\left(\omega.t - \vec{k}.\vec{r} - \varphi_{01}\right) + \vec{G}_{02}.\cos\left(\omega.t + \vec{k}.\vec{r} + \varphi_{02}\right);$$
(7.3-24)

where: $\vec{G}_{01}$ and $\vec{G}_{02}$ are amplitudes of the waves; $\omega = 2.\pi.\nu$ – angular frequency at wave frequency ν_g of GF; $k = \dfrac{\omega}{\nu_g}$ – wave vector; t – time; r – distance; φ_{01} and φ_{02} – the phase difference.

Let, for convenience of the analysis, only one of the waves in (7.3-24) is discussed by assuming that there exists only the first wave, i.e.

$$\vec{G}_{01} \neq 0; \vec{G}_{02} = 0 \tag{7.3-25}$$

and at moment

$$\text{a) } t = 0; \rightarrow \text{ b) } r = 0 \rightarrow \varphi_{01} = 0 = \varphi_{02} = 0. \tag{7.3-26}$$

Then the amplitudes of GF for one semi-period which is $t = \dfrac{T}{4} = \dfrac{1}{4.\nu}$ should be heteropolar $\vec{G}_{01} > 0$ and $\vec{G}_{01} < 0$, and they are:

$$\text{a) } t = \frac{T}{4}; \text{ b) } \omega.\frac{T}{4} = \frac{\pi}{4}; \rightarrow \text{ c) } \vec{G}(r.t) = -\vec{G}_{01} < 0; \tag{7.3-27}$$

$$\text{a) } t = \frac{3}{4}T; \text{ b) } \omega.\frac{3}{4}.T = \frac{3}{4}.\pi \rightarrow \text{ c) } \vec{G}(r.t) = -\vec{G}_{01} < 0; \tag{7.3-28}$$

It follows from (7.3-27) and (7.3-28) that during the first wave, GF should alter between amplitudes $\vec{G}_{01} < 0$ and $\vec{G}_{01} < 0$. Id est GF could not realize these gravitational waves, which would be described by $\vec{G}(r,t) = \vec{G}_{01}$.

$$\vec{G}(r,t) = \vec{G}_{01}.\cos\left(\omega t - \vec{k}.\vec{r}\right); \tag{7.3-29}$$

which in wave processes must obligatory be bipolar, according to $\vec{G}_{01} > 0$; $\vec{G}_{01} < 0$, and they are not (7.3-27) and (7.3-28). As it is known, according to (7.3-14), GF is only unipolar. This real scientific fact implies that in order to describe a reverse wave of amplitude $\vec{G}_{02}$, a bipolar GF is required, and it is not bipolar, because there is no independent GF without electromagnetic matter.

The real circumstances, expressed through (7.3-20) and (7.3-21) categorically show that GF is indeed only unipolar and eddy-free. In GF, there are no alternative components, such as are $\vec{E}$ and $\vec{H}$, which are described by Maxwell's equations. This is one of the reasons to reject the existence of independent gravitational waves. *All this proves that (7.3-25) cannot be written for GF* – A FACT, WHICH CLEARLY AND CATEGORICALLY CONFIRMS THAT THERE ARE NO GRAVITATIONAL WAVES AND THAT GRAVITATIONAL WAVES CANNOT EXIST, SINCE GF IS ONLY UNIPOLAR AND DOES NOT HAVE ANY EDDY COMPONENTS. MOREOVER, IT IS ESSENTIAL TO POINT OUT THAT THE THEORY OF RELATIVITY (TO) HAS NEVER CLAIMED OR PROVED THAT A BIPOLAR GF EXISTS, NOR THAT A GF EXISTS, WITHOUT A GENERATOR AND WITHOUT A MATERIAL CARRIER. On the contrary, from equation (7.3-20) it directly follows that the carrier and generator is matter (mass) of a normal kind (electromagnetic matter). *This subsequence from (7.3-20) directly confirms that GF of the General Theory of Relativity should only be unipolar and is always inseparable from matter (mass),* A CIRCUMSTANCE, WHICH CATEGORICALLY DISPROVES ANY POSSIBILITY TO GENERATE INDEPENDENT (WITHOUT ELECTROMAGNETIC MATTER) GRAVITATIONAL WAVES AND WHICH AT PRESENT HAS NO EXPERIMENTAL CONFIRMATION.

Thus, it has been ascertained for the gravitational field that:

First. **It cannot exist without being directly bound to the mass of substantial or field electromagnetic matter which generates it.**

Second. **It is electromagnetic - a secondary electromagnetic field, which is only unipolar.**

THIRD. SINCE THE INDEPENDENT FIELD WAVES REQUIRE BIPOLARITY OF THEIR AMPLITUDES, **AND SINCE THE GRAVITATIONAL FIELD IS ONLY UNIPOLAR, IT IS IMPOSSIBLE FOR INDEPENDENT GRAVITATIONAL WAVES TO EXIST WITHOUT ELECTROMAGNETIC MASS (ENERGY) TO CARRY AND GENERATE THEM, I.E.** *THERE ARE NOT AND THERE CANNOT BE INDEPENDENT GRAVITATIONAL WAVES.*

Fourth. The dimensionality of gravitational field is a dimensionality of acceleration.

$$G \rightarrow \frac{[m]}{[S^2]} = \frac{\text{distance}}{\text{time squared}} = [a] = \text{acceleration}; \tag{7.3-30}$$

Fifth. The distance r in the nominator of the formula of gravitational field is in power 2 only in cases when:

a) the quantity of matter m of the body is volumeless (V = 0), i.e. m can be reduced to a point;

b) when the dimensions r_1 and r_2 of the bodies interacting gravitationally are much smaller than the distance R between the body and the generator of GF $r_1 \ll R_1$ and $r_2 \ll R$, which attracts the body

7.3.2.4. How good is the motivation for the hypothesis that at small distance, below 10^{-16} m, gravitational forces prevail over electromagnetic forces

THE ANALYSIS MADE HERE IS BASED ON THE CIRCUMSTANCE THAT UP TO THIS MOMENT NO EXPERIMENTAL FACT HAS BEEN PRESENTED TO PROVE THAT THERE IS INDEPENDENT GRAVITATIONAL FIELD, WHICH HAS NO CARRIER (GENERATOR) SUCH AS SOME STRUCTURE OF MATTER (ELECTROMAGNETIC MATTER).

Let us now take a look at the elementary particles in the form of substantial (fermion) particles, such as the electron e^- with mass $m_{e0} = 9,1.10^{-31}$ kg, proton e^+ with mass $m_p = 1,672 = 10^{-27}$ kg and neutron $m_n = 1,674.10^{-27}$ kg.

The electrostatic force between two electrons e_1 and e_2 with masses $m_{e1} = m_{e2} = 9,1.10^{-31}$ and electric charges $q_{e1} = q_{e2} = 1,6.10^{-19}$ C is

$$F_e = \frac{q_1.q_2}{4.\pi.\varepsilon_0.r^2} = \frac{\left(1,6.10^{-19}\right)^2}{4.\pi.8,85.10^{-12}.r^2} = \frac{2,56.10^{-38}}{111,156.10^{-12}.r^2} = \frac{2,3.10^{-40}.10^{12}}{r^2} = \frac{2,3.10^{-28}}{r^2}[N]; \qquad (7.3\text{-}31)$$

The gravitational force between the masses of two electrons is

$$F_{Ge} = \frac{q_{e1}^2.q_{e2}^2.k_m^2.\gamma}{r^2} = \frac{m_{e1}.m_{e2}.\gamma}{r^2} = \frac{81,82.10^{-63}}{r^2}.6,673.10^{-11} = \frac{5,46.10^{-72}}{r^2}[N]; \qquad (7.3\text{-}32)$$

The ratio of F_{Ge} to F_e

$$\frac{F_{Ge}}{F_e} = \frac{5,46.10^{-72}}{2,3.10^{-28}} = 2,402.10^{-43} \text{ times} \qquad (7.3\text{-}33)$$

I.e. the ratio of the gravitational forces to the electromagnetic forces of two electromagnetic objects is $2,402.10^{-43}$ times.

The relationship between the density of the mass ρ_m and the effective square of electric charge of a body with mass m_T is $Q_T^2 = \dfrac{m_T}{k_m}$.

Under these conditions the gravitational forces between two equal in value densities of masses $\rho_T = 10^{17}$ kg.m^{-3}, such as the density of the mass of the nucleus of an atom, at distance r from each other is

$$F_{G\rho} = \frac{\rho_T^2.\gamma}{r^2} = \frac{10^{34}.\gamma}{r^2}; \qquad (7.3\text{-}34)$$

And the electric force between the effective densities of electric charges Q_{Tm}^2 of these masses is:

$$F_{e\rho} = -\frac{Q_\rho^2.Q_\rho^2}{4.\pi.\varepsilon_0.r^2} = \frac{\rho_T^2}{k_m^2.4.\pi.\varepsilon_0.r^2} = \frac{10^{34}}{k_m^2.4.\pi.\varepsilon_0.r^2}; \qquad (7.3\text{-}35)$$

The ratio between these forces is

$$K_F = \frac{F_{G\rho}}{F_{e\rho}} = \gamma.4.\pi.\varepsilon_0.k_m^2 = 6,673.10^{-11}.4.\pi.8,85.10^{-12}.\left(3,55.10^7\right)^2 = 9,34.10^{-6}; \qquad (7.3\text{-}36)$$

which does not depend on the distance between masses ρ_m, since it refers to forces between the same masses, i.e. it also holds true for very small distances and for great and small densities of masses and their respective densities squares of electric charges $Q_T^2 = \dfrac{\rho_T}{k_m}$.

In this sense, in great densities of masses $\left(\rho_T = 10^{17} \text{ kg.m}^{-3}\right)$ the ratio K_F between their gravitational and electromagnetic forces is relatively small $K_F \equiv 10^{-6}$.

IN THIS SENSE, THERE IS NO REASON TO DISCUSS THE HYPOTHESIS AT GREAT DENSITIES OF MASSES $\rho \gg 1$ AND AT SMALL DISTANCES $r \ll 1$, THE GRAVITATIONAL FORCES CAN BE PREVALENT, SINCE THE EXAMPLE CALCULATED HERE REJECTS THIS HYPOTHESIS, SINCE K_F DOES NOT INVOLVE EITHER ρ, OR R.

7.3.3. Examples of gravitational fields

What the expressions about gravitational forces and gravitational fields indicate for some specific shapes of bodies, which are attracted by a point-like source of a gravitational field.

First case. Attracting a body in the form of a rod
Case A. *Rod B is perpendicular to the gravitational field of a point-like body A.*
Such a case is shown in Fig. 7.3.1 a.

The rod has a homogenous density of mass ρ, square cross-section with sides of a unit of length and the length of the rod is $2l$.

If we consider it relative to a system of coordinates xy, placed in its center, an elementary volume of the rod at distance x from its beginning with volume $dV_x = 1.1.dx$ and mass $dm_x = \rho.dv = \rho.dx$ the rod, according to (7.3-1), is attracted by body A of mass m_A by force

$$d F_{xy} = -\frac{m_A.\gamma.dx.\rho}{H^2 + x^2}; \tag{7.3-37}$$

This force has a projection upon axis y and x

$$\text{a) } dF_y = -m_A.\rho.\gamma.\frac{H.dx}{\left(H^2 + x^2\right)^{3/2}}; \quad \text{b) } dF_x = -m_A.\rho.\gamma.\frac{x.dx}{\left(H^2 + x^2\right)^{3/2}}; \tag{7.3-38}$$

from which, after integrating we have forces

$$F_y = F_{AB1} = \int_{-l}^{l} dF_y = -m_A.\rho.\gamma.\frac{2l}{H\left(H^2 + \ell^2\right)^{1/2}}; \tag{7.3-39}$$

$$F_x = F_{ABX} = \int_{l}^{0} dF_x = m_A.\rho.\gamma.\frac{\left(H^2 + \ell^2\right)^{1/2} - H}{H.\left(H^2 + \ell^2\right)}; \tag{7.3-40}$$

*The integral of F_x is only for one side of the rod and gives the force in one arm, while for both arms the forces are F_x and $-F_x$ oppositely directed, i.e. it **presses the rod toward shortening**.*

If the force of attraction of body B by body A is calculated under Newton's condition

$$\ell \ll H; \tag{7.3-41}$$

we have

$$\vec{F}_x = \vec{F}_{AB1} = -m_A.\rho.\frac{\gamma.2\ell}{H^2}.\vec{r}_0; \tag{7.3-42}$$

The ratio of force $F_y = F_{AB1}$ to force F_{AB10}, calculated under condition (7.3-41), respectively under (7.3-1), which is

$$\vec{F}_{AB10} = -m_A.\rho.\frac{2l.\gamma}{H^2}.\vec{r}_0; \tag{7.3-43}$$

is

$$K_{F1} = \frac{\left(H^2 - l^2\right)^{1/2} - H}{H^3\left(H^2 + l^2\right)} < 1; \tag{7.3-44}$$

Inferences
1. It follows from F_y (7.3-39) and (7.3-42) that for the case in Fig. 7.3.1 a, the real gravitational force F_y is always smaller than the one calculated under conditions (7.3-41), respectively under (7.3-1).
2. WHEN THE ATTRACTED BODY **B** HAS A DIMENSION PERPENDICULAR TO THE GRAVITATIONAL FIELD OF BODY **A**, WHICH ATTRACTS IT, THE BODY GENERATES TRANSVERSE GRAVITATIONAL FORCES, WHICH SEEK TO SHORTEN THE BODY IN DIRECTION PERPENDICULAR TO THE FIELD OF BODY **A**.
3. The previous two inferences (1 and 2) indicate that it is necessary to further develop Newton's gravitation in order to clarify the effects, which are generated when a body has volume $V \neq 0$.

Case B. *Rod B whose axis coincides with the direction of the gravitational field of body A.*
The rod has a square cross-section, its sides measuring one and its length 2ℓ, as fig. 7.3.1 b shows.

At distance y along the axis y is the elementary volume $dV_y = 1.1.dy = 1.dy$, in which there is mass $dm_y = \rho.dy$, attracted by body A with force

$$dF_{AB2} = dF_y = -m_A \cdot \frac{dm_y.\gamma}{(H+y)^2}; \qquad (7.3\text{-}45)$$

The resultant force F_{AB2}, by which body A attracts body B is

$$F_{AB2} = \int_{-\ell}^{+\ell} dF_y = -\frac{m_A.m_B.\gamma}{H^2 - \ell^2}; \qquad (7.3\text{-}46)$$

For this case, the force calculated under condition (7.3-41), respectively under (7.3-1) is

$$F_Y = \vec{F}_{AB20} = -\frac{m_A.m_B.\gamma}{H^2}.\vec{r}_0; \qquad (7.3\text{-}47)$$

The ration of F_{AB2} to F_{AB20} is

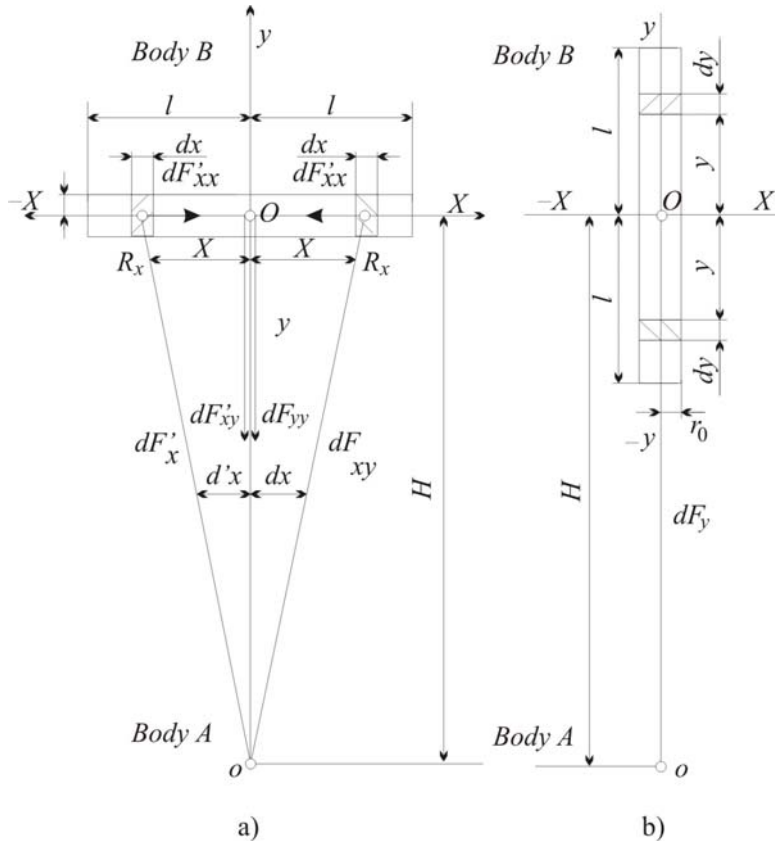$$K_{F2} = \frac{H^2}{H^2 - \ell^2} \geq 1; \qquad (7.3\text{-}48)$$

Fig. 7.3.1.

Inferences
1. THERE IS NO TRANSVERSE FORCE IN CASE **B**
2. IN CASE **B** THE REAL FORCE IS ALWAYS GREATER THAN THE ONE CALCULATED UNDER CONDITION (**7.3-41**).