Place of Science in the Human Knowledge

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ABSTRACT

The simple model for the classification of knowledge is suggested. The four types of knowledge are considered: customs, arts, religions and sciences. The strict definition of science is suggested to distinguish it from other kinds of knowledge and from pseudo-science. The model indicates the methodology of the scientific research that is aimed to avoid conflicts between science and other kinds of knowledge. This approach is suggested to exclude some concepts from the scientific knowledge by some formal criteria at very beginning of the consideration.

Keywords: Fundementals of physics; metodology; Mizugadro; physical mathematics; religion; science; TORI Axioms.

2020 Mathematics Subject Classification: 00A30; 00A35; 00A99.

1. PREFACE

This research is motivated by huge amount of fake results. Many of them pretend to be scientific. Especially grave the frauds are in Russia, due to the total corruption [1]. An example [2,3,4] of a fraud is shown in Fig. 1.

Fig. 1. Idea of inertioid [2,3,4]

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The bulletin [5] collects warnings about the danger tendencies in the development of the Russian science in century 21, and indicates many cases of the abuse.
The abilities of pseudo-scientists to publish tricks greatly exceed the abilities of enthusiasts to analyze and to criticise them. Then, the budget used for the money laundering, leaving no support for the scientific research. We need formal criteria to identify peseudo-scientific results. Such criteria are main topic of this article. The criteria use the classification [6,7] of the Human knowledge, mentioned in the title.

The Russian version of this article [6] provides the definition of science, that allows to qualify some results as non-scientific by the formal criteria, at very beginning of the consideration. That definition follows from the simple exercise [7], which, in its turn, is based on the ideas of refutability of scientific concepts, these ideas had been developed by Karl Popper [8,9,10] in the past century. However, the similar phenomena of pseudo-science take place not only in Russia; this motivates me to make this English version.

2. ABOUT TRUTH

Often, it is supposed, that the scientific research is true, correct, and the pseudo-scientific research is false, wrong, non-correct; so, for the qualification of any concept, it is sufficient to check it, to verify it, and, if it is wrong, to reject is. Such a common sense looks reasonable, but the abilities of pseudo-scientists to write the wrong papers and get foundation for pseudo-science greatly exceeds the abilities of scientists to criticize them, to reveal errors and to indicate, that some research is just wrong.

In this paper, the different approach is suggested. The idea is not to criticize each wrong concept, but to suggest the narrow definition of term “Science" in such a way, that any concept can be qualified as “scientific" or “non-scientific", whenever this concept is correct or wrong. This cannot substitute the common sense, mentioned above, but gives some formal criteria, that allow to reduce the amount of results, that deserve serious consideration.

Many Russian colleagues at school had to accept the strange concepts:

1. *Our Universe is infinite both in space and in time.*
2. *For photosynthesis, the green leaves use the central part of the visible spectrum of solar light.*
3. *The gradual evolution of a species with genotype of 48 chromosomes (monkey) led to the new specie with genotype of 46 chromosomes (mankind).*
4. *The communism in the USSR will occur within 20 years* [11,12]

Such concepts were suggested at the Soviet schools as a “scientific truths". However, they are neither true, nor even scientific. At least they do not fit the definition of science, suggested below in section 8.

The Soviet veterans continue their attempts to declare the postulates of Sovietism (that, are I think, just wrong) as a truth, as scientific facts; the attempts to understand, what happened in century 20, why the communism was not built-up, why the USSR collapsed, why Russia become a base of prime products, etc. are declared as ‘pseudoscience’ and ‘false history’ [20,21].

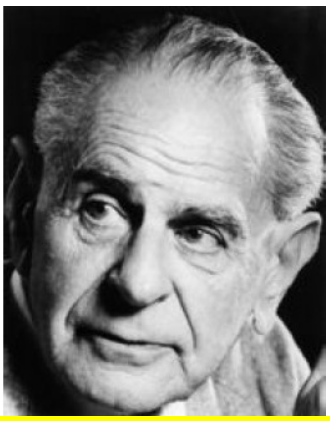
The list of popular wrong concepts could be much longer; many of then can be qualified as *sovetism*, that appears as a kind of religion, although the teachers had declared them to be scientific facts.

The goal of this article is systematization, classification of the knowledge in such a way, that many pseudo-scientific concepts can be disqualified at once. The formalism had constructed for Physics (for needs of the Quantum Optics and Laser Science), but it applies also to other sciences.

In this work, the simple model of the classification of the human knowledge is suggested. This model includes only four categories: **customs**, **arts**, **religions** and **sciences**. The definition of science had appeared first in the short version about non-traditional concepts [7]. Here, knowledge is ability to generalize the experience in a compact form and to transfer it to other individuals. Religions are important kind of knowledge [14], and they should be distinguished from sciences.

3. OBJECTIVITY

Past century, Karl Popper had formulated the criteria that allows to identify the special, extremely efficient kind of human knowledge [8,9,10]. He called it *science*, although the term *science* was used before in a little bit different meaning; that meaning included the claim of objectivity: *I frame no hypothesis*, Isaac Newton wrote [16]. Roughly speaking, the science was considered to be a truth, that does not need any refutation. Popper, contrary, suggests the criterion of refutability as the key property of science, modifying the meaning of term “science".



Karl Popper, 1980’s. (from Wikipedia)

For Popper, the thing that makes a concept *scientific* is not its *objectivity*, but the possibility to verify it, to falsify it, to criticise it arguably and to refute it [8]:

1. *It is easy to obtain confirmations, or verifications, for nearly every theory - if we look for confirmations.*
2. *Confirmations should count only if they are the result of risky predictions; that is to say, if, unenlightened by the theory in question, we should have expected an event which was incompatible with the theory - an event which would have refuted the theory.*
3. *Every “good" scientific theory is a prohibition: it forbids certain things to happen. The more a theory forbids, the better it is.*
4. *A theory which is not refutable by any conceivable event is non-scientific. Irrefutability is not a virtue of a theory (as people often think) but a vice.*
5. *Every genuine test of a theory is an attempt to falsify it, or to refute it. Testability is falsifiability; but there are degrees of testability: some theories are more testable, more exposed to refutation, than others; they take, as it were, greater risks.*
6. *Confirming evidence should not count except when it is the result of a genuine test of the theory; and this means that it can be presented as a serious but unsuccessful attempt to falsify the theory. (I now speak in such cases of “corroborating evidence".)*
7. *Some genuinely testable theories, when found to be false, are still upheld by their admirers - for example by introducing ad hoc some auxiliary assumption, or by reinterpreting the theory ad hoc in such a way that it escapes refutation. Such a procedure is always possible, but it rescues the theory from refutation only at the price of destroying, or at least lowering, its scientific status.*

The requirement of refutability opposes the *believe* in the ability to get some *objective* knowledge [17]:

Objective truth is that part of our knowledge which correctly reflects reality and does not depend upon the subject, i.e. on human consciousness and will. Objective method, therefore, means the method that leads to knowledge of objective truth. For materialism, ‘the recognition of objective truth is fundamental’; consequently all materialist science must be objective in method.

However, there where were still some doubts about the humanitarian science, but the *objectivity* of the natural sciences was *believed* to be well established and irrefutable. Popper denies even this belief. This was not accepted [18] by several researchers; they suggest the non-refutable concepts in

hope, that they do namely science, but not a religion. However, the qualification of such activity as *science* or *religion* depends on definition of science and on definition of religion. This indicates the need to elaborate the appropriate definitions, they are provided below in the special sections. The human knowledge is classified a way, that does not allow science to deal with non-refutable concepts.

Many authors pretend, that their results are *true*; so true, they do not need to allow any refutation (sometimes, the term *falsification* is used in the similar meaning). This leads to the growth of various pseudosciences, which may be extremely efficient in getting foundation, but useless in any other application.

The identification of pseudoscience versus science is not trivial. It is especially grave in Russia: in the USSR, in its time, even the theory of relativity, quantum mechanics, cybernetics were suppressed as pseudosciences [22]; the genetics and psychiatry were exterminated [23,24,25,26,27]. The destructive activity was accompanied with demagogy about “objectivity", science and pseudoscience.

Even defenders of the *objectivity* mention the danger of pseudoscience [30]. Both pseudoscience and the struggle against it are dangerous for science [31], while the development of science should allow the *scientific revolutions* [32]. The distinction between science and pseudoscience is necessary. The criteria to identify science should be adjusted; this is one of goals of this article.

The conflict between the interpretation of science by K. Popper and that by the objectivism is terminological: what kind of knowledge do we call “science". Below, the terminology is adjusted; in this article, the term “science" in used in the Popper’s interpretation; however, even more requirements on the scientific hypothesis are formulated.

The classification suggested below does not refer to the correctness or wrongness of a concept. Even the concept about the existence of the “Mizugadro’s number" [33] (which seems to be completely wrong) should be considered as scientific, if the ways of the verification and the negation are indicated. Then, the classification easily accepts the less radical “scientific revolutions" such as, negation of concepts of the universal time for all observers, or that of trajectory as universal description of movement, or that of conservation of number of atoms of each kind in any isolated system. Even hypothesis that implies violation of law of conservation energy-momentum in a closed system, or hypothesis about non-conservation of number of dollars in a financial pyramid can be considered as scientific, if this violation is declared by the author(s) and a way to reject, refute this hypothesis is suggested.

Pseudo-science can be defined as any knowledge (perhaps, wrong knowledge), that pretends to be science, being no science. Then, the pseudo-science is determined as soon as Science is defined.

The pseudo-science may have various forms, like a computer virus. If the operational system has a backdoor, the significant part of the resources is spent to identify the new and new viruses in order to disable them. The more appropriate solution is some “open" operational systems that have internal protection and have no need to be a secret (and may be open to public). Dealing exclusively with such open operational systems, one has no need to fight against viruses.

In the similar way, it is vain to identify and classify all kinds of pseudosciences one by one. Following Karl Popper, one should accept, that the main property, that distinguishes science from religions (whenever the concepts are true or false), is neither an *objectivity*, nor a *truth* of concept, but the way the concept is constructed and its attitude with respect to other concepts. The scientific concept may be false, but it should provide ways to reveal it; then, even if the concept is wrong, it remains scientific.

If Liugi Galvani, after his experiments with the electric excitation of muscles of dead frogs [34] would begin to eliminate and to destroy the colleagues, who had expressed doubts in his results (instead of to allow them to reproduce the effect), then, such a “galvanism" should be qualified as pseudoscience (although his experiment is easy to reproduce).

In order to identify a pseudo-science, this paper suggests to classify the human knowledge and indicate the place of science there. Then, all the rest will be pseudo-science.

4. CUSTOMS

The category of customs includes not only the commonly accepted behavior of humans, but also the habitual semantics of commonly used human languages. Even the custom habit to drink vodka from the bottle, shown in Fig. 2, should be considered as knowledge. Meaning of words is also custom.

Fig. 2. Custom [13]

The usual meaning of the Bible is custom, widely accepted in the Christian community. The sentence *You shall love your neighbor as yourself* allows various interpretations [35, 36], dependently on the meaning of the word *love* and its Hebrew and Aramaic equivalents. Some an interpretations are not popular; so, they are not a custom. The interpretations of the New Testament by Tim Rice [37] and that Michael Bulgakov [38], due to the wide spreading, can be qualified not only as an art, but also as a custom, at least in certain literature or musical communities. Such an interpretation should be qualified a knowledge. In such a way, the meaning of words appear as a knowledge.

The folklore also falls in the category of custom. It is any knowledge that is difficult to investigate by the any systematic methods. Any legend, story, narration leaves from category folklore, from category “custom" and becomes art or even science (history), as soon as it is written, published, exposed and considered in a scientific way as a historic evidence.

The semantics of the human languages and their understanding, the meaning of words is important part of a language. It forms the most important part of the human knowledge. Namely this kind of knowledge gives sense to other kinds of knowledge, considered below.

5. ARTS

Few examples of objects I consider as art [15] are shown in Fig. 3. In order to be more specific, I suggest the definition below:

Art is any kind of knowledge that is free from internal rules and is realized in a reproducible form that allow its systematic investigation: Such a definition corresponds to a goal formulated in the introduction, although it slightly reduces the set of things which could be called *art*. Usually a product of art has the following properties:

A1. Beauty: Here, the beauty is the extensive ability of any unexpected use. The prehistoric hunter, painting and observing an image of an animal on a rock, may guess how to catch this animal; the reader, laughing on a comedy, may ask himself: *Either I am free from all the evils shown?* - although the primary goal could be just laugh.

A2. Absence of structure: Intents to bring into the arts rules are not efficient. The arts use all other knowledges; the same product may have both artistic and scientific value.

A3. Wisdom: A painter, a writer, any artists with their works say more, than they planned to say, and more, than they understand by themselves. In this sense, the product of art may be wiser than the author.

A4. Entirety: Intents to correct, to improve a product of art destroy it.

A5: Amoralism: Creatures that have goal to bring some moral to the society, have low artistic value if at all; the creature may violate any taboo of the society. Including the religious ones.

There are special sciences about the art. Aiming the specific application of the classification, the topics of customs and arts are presented here only declaratively.

Fig. 3. Arts: Five examples of works by various artists [39,40,41,42,43]

6. RELIGIONS

Religion is kind of the human knowledge based on some (specific for each religion) set of irrefutable concepts, believes, texts, symbols and performances. [14]

Usually, any religion is characterized in the most of following:

R1. The existence of at least one God is presumed.

R2. There exist canonical sacred text, that allow the humans to guess the will of God(s) and follow it.

R3. God like some actions of human, these actions are called Good.

R4. God dislike some actions of human, these actions are called Evil.

R5. The suggested set of concepts pretends to play an organizing role in the society: The following to namely this religion provides abilities for the kindness, prudence and wisdom significantly wider, than any other religions.

It this article, God is generic term denoting any intelligent subject that in some way (that is not available for humans) has abilities that greatly exceed those of a human. Actions related to these abilities are called miracles, marvels.

God may look like a human (Jesus Christ, Buddha, Lenin), but also can be “non-material" (God - Holy Spirit, World Revolution, Marxism). God may be omnipotent (almighty), invincible, immortal and predicts future:

The Marxist doctrine is omnipotent because it is true. [44]

Long live invincible marxism-leninism-mao tsetung tonight. [45]

Lenin lived, Lenin lives, and Lenin will live. [46]

The generation of those who are now fifteen will see a communist society, and will itself build this society. [11]

The immortal beacon of Comrade Stalin will forever illuminate the path on which the Chinese people march forward. [47]

And he said unto Abram, Know of a surety that thy seed shall be a stranger in a land that is not theirs, and shall serve them; and they shall afflict them four hundred years [48].

World religions, each in their own way, offer a unique set of moral values and rules to guide human beings in their relationship with the environment [49].

Often, such rules are presumed to be truth without limits and alternatives:

The law of the LORD is perfect, restoring the soul; The testimony of the LORD is sure, making wise the simple. [50]

... he who chooses a religion other than Islam, it will not be accepted from him, and in the everlasting life he will be among the losers. [51]

The general concept of religion is illustrated in Fig. 4. Some religions do not identify themselves as religions, pretending to be sciences [59,60]. The adepts consider their own belief as the only true concept, deny the dogmatic character of their believes [61] and treat any deviant behavior as crime, heresy and mental illness; the wrong-believers are punished or undergo the forced medical treatment [24,25,26,27,28]. Some religions justify lies, sacrifices, betrays, massacre, murdering and wars, if they serve the needs of God: *You cannot make revolution in white gloves* [29].

Fig. 4. Religions: Illustrations by S. Tihomirov [52], V. Shmakov [53], O. Kuvaev [54]

Most of religions avoid any refutable concepts. The concept is called refutable, if (and only if) in terms if this concept, some specific observation can be described that negates the concept. For example, the statement *The Party officially declares: The current generation of the soviet people will live in communism* [62] is refutable: based of such a declaration, the next generations (say, since year 1980)

may shame judge and punish, execute the soviet veterans as liars and impostors. Within few generations after creation of a new religion, it abandons and forgets all its refutable concepts and becomes more stable. Here are the examples of irrefutable concepts: *God blesses America, or Imperialism is evil, or God gives the immortal soul to everyone, or The righteous will be at Heaven*.

The canonic texts describe the marvels, miracles that are specific for each religion. The miracle may refer to the magic conversion of water into vine, to the drastic increase of the efficiency of the production by the inspiration of the Führer, catching of the spies by children, destruction of an army of the enemy tanks by several heroic soldiers launching grenades, etc.

The definition in the beginning of the section does not specify features R1-R5 as necessary; so, many kinds of knowledge fall into the definition of religion. In particular, it includes the *shintoism* [63] and the *civil religions* [64,65,66,67], although these religions do not pretend to be the “only true" knowledge and Gods in these religions are not omnipotent.

Religions form significant part of the human knowledge and play important role in the human history. While a religion is tolerant with respect to other kinds of knowledge (and in particular, to other religions), it may assist the prosper development of the society. No one religion can substitute other kinds of knowledge, end even other religions, as one specific science cannot substitute all other sciences. The society, where any religion dominates in an aggressive way, becomes barbarian compared to other countries within few generations; the people of such a society lose the ability to analyze the information.

7. SCIENCES

As it was mentioned in the second section, the term “science" may have different meanings. Following K. Popper, in this article, this term applies only to a refutable knowledge. In order to distinguish science at the background of pseudoscience and religion, the term *science* should be defined as follows:

Science is kind of knowledge, activity and notations, based on concepts that have all the six properties below:

S1. Applicability: Each concept has the limited range of validity, distinguishable from the empty set.

S2. Verifiability: In the terms of the already accepted concepts, some specific experiment with some specific result, that confirms the concept, can be described.

S3. Refutability: In the terms of the concept, some specific experiment with some specific result, that negates the concept, can be described.

S4. Self-consistency: No internal contradictions of the concept are known.

S5. Principle of correspondence: It the range of validity of a new concept intersects the range of validity of another already accepted concept, then, the new concept either reproduces the results of the old concept, or indicates the way to refute it. (For example, the estimate of the range of validity of the old concept may be wrong.)

S6. Pluralism: Mutually-conflicting concepts may coexist. The coexistence of mutually-conflicting concepts, satisfying requirements S1-S5 above is allowed. If two concepts satisfying S1-S5 have some common range of validity, then, in this range, the simplest of them has priority and should be considered as main, principal.

Note that in the definition of science, all the six properties are compulsory. For example, if the range of validity of a concept is the *full set* (id est, the concept is valid every time and everywhere), then, by definition, it is not scientific, as it does not satisfy the criterion S1, and there is no need to check properties S2-S6 to qualify such a concept as non-scientific.

I illustrate schematically term “science" in Fig. 5.

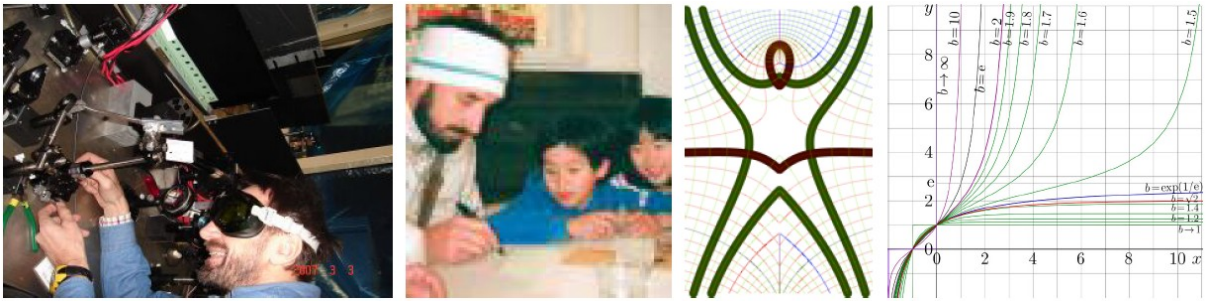


Fig. 5. How to draw Science? [55, 56, 57, 58]

Scientific concepts are built on the base of observations, experiments, definitions, axioms, hypothesis, theorems and theories.

Observation means identification of some phenomena which are in some sense similar.

Definitions allow to use compact notations, making the description of scientific concept shorter and simpler.

Axioms are statements that are considered as initial at the building-up of some concept. Set of few concepts with commonly accepted axioms is called “paradigm".

Theorems are statements that are proven on the base of axioms and definitions. Sometimes, this term is used even in those cases then the proof of the statement is not yet constructed, but is expected to be constructed in future. In such a case, term “hypothesis" or “Conjecture" is more suitable.

If the hypothesis is deduced from the postulates and other, already proven theorems, it becomes theorem. If a hypothesis had predicted some non-trivial results of observations or experiments, it becomes theory.

Activity, related with development of new concepts is called research. The most important classification of sciences is based on the subject of the research, the goal and the methods, that dominate in the research: humanitarian - natural, fundamental - applied and theoretic - experimental.

In principle, such a structure could be applied to all the sciences. Not all sciences are developed sufficiently to allow the use of the full scheme above. The search for “mathematics in history” return links about history of mathematics: the historians describe history of mathematics rather than use mathematics in description of historical events. The known exception is the prediction of collapse of the USSR in century20 by Andrei Amalrik [77], “calculated” the collapse of the USSR during century 20. Since century 21, the calculus, the mathematics enter to all sciences, even to psychiarty [100].

8. HIERARCHY OF SCIENCES

Mathematics makes the basis of other sciences. No one science dare to contradict mathematics. The computational mathematics and cybernetics provides a bridge between mathematics and other knowledge. The general physics and theoretical physics relate mathematics with other sciences, although some sciences (even humanitarian ones) may use, for example, the statistical methods without to refer to physics.

If some science, concept contradicts the basic paradigms of mathematics of physics, then, according to S5, there should be indicated a way to see that they are wrong. To avoid the confusions, the term *science* should be used only in the sense of the definition above. In all other cases, terms

pseudoscience, *sovietscience*, *christianscience*, *quasiscience* may be used to specify, that some activity or knowledge looks similar to science or similar to a scientific research.

9. SCIENCES AND THE SOCIETY

Usually the sciences, and especially the fundamental ones do not give a fast benefit. The spending of the budget funding to support the satisfaction of the personal curiosity of researchers requires some justification. There were intents to submit the development of science to other goals (creation of facilities of the modernization of the industry, or increasing of the military power of a country, etc.). Some researches, especially applied ones, can be motivated in such a way; and sometimes the results have the scientific value. However, often the results of such a research are just fake. During the human history, there was not developed more efficient motivation for science, than curiosity of researchers who do it. Yet, there is no other way to make the deep science. However, the needs of industry can be mentioned as motivation for the financial support of the curiosity of researchers.

The distribution of funds assigned for the development of science is serious problem. Administrators of funds cannot drill deeply into the research they finance. The funds are distributed on the base of the formal criteria: publications, citation, participation in the conferences. The ability to write the grant applications and good relations with colleagues and the distributors of funds become important, if not dominant, factor in the success in the getting of the financial support. For the same reason, the spectacular nature of the new effects is important for its promotion.

Especially non-efficiently the funds are sent in the countries with corrupted bureaucracy; and not only because the significant part of foundation is spent for bribes and the private security. The government being unable to keep the growth of the technology of the country at the international level begins to secret the scientific achievements in order to enable the monopolistic use in the military industry. Often, the results are fake: the secrecy protects them from critics and opens wide field for both wanted and unwanted errors.

In a totalitarian country, some sciences are not only left without foundation, but are affected by the physical repression of researchers, as it happened in the USSR with the theory of relativity, quantum mechanics, cybernetics and genetics [31,21,22,23]. Previously, in Europe, in the epoch of the Holy Inquisition, the similar phenomena took place with respect to astronomy.

The properties 1-6 allow to separate scientific concepts from others without fighting the pseudosciences.

10. ABOUT THE TERMINOLOGY

Often the errors are caused by a smooth, fussy definitions of terms and the concepts.

The most crying examples refer to the humanitarian science.

In 2009, Dmitry Medvedev had announced the setting up of a commission to counter the falsification of history [19,20]. This makes the Russian concept of history *non-refutable* (not falisifiable) and disqualifies it as a science. There is still hope, that this is just terminological confusion, and that commission does not have aim to destroy the historic science. The aim of this paper is not to provoke conflicts, but to mitigate them. Therefore, I suggest not to use words “falsification", “falsifiability", at least in the scientific texts. Such terms are ambiguous, they may mean either the negation of a concept for the contradiction to observations or the misinformation.

Any term that has two opposite meanings should not be used at all. With respect to historical texts (whenever they scientific or not), the terms *revisionism*, *opportunism* and *reformism* appear in the similar (ambiguous) meaning [70,71], but the term *refutability* does not seem to be used in such a way.

In this paper, the term “refutability" is used. However, if refutation of the Russian official version of history will be also prohibited, then will be no way to attribute the confusion to terminology, and that concept should be qualified as non-scientific.

11. IMPORTANCE FOR PHYSICS

The author would not like to teach colleagues, what to write and how to write, but just indicate, what properties make the research scientific. This section explains, why I boil up so old question, and why it is important for physics.

The author used to meet several “strange" concepts that pretended to be scientific. The examples are:

Quantum annihilation of the optical soliton [72].

Analysis of the statistical significance of a “second” peak at the correlation function for the clusters of galaxies, using the model of random (Poisson, independent) distribution of these clusters. This model does not take into account clasteriation of these clusters (the clusters, by themselves, often are close to each other). The “first” peak at the correlation function rejects, refutes this model at the hugh significance level; so, this model cannot be used for the estimates of the statistical significance of the “second” peak [73].

Extrapolation of the quasi-optical approximation in the atmospheric physics [74].

The “radius of convergence" of the primary series of the theory of perturbation [75].

Quantization of the magnetic flux in a free space [76].

Violation of the McCumber relation for e ective cross-sections of emission and absorption in laser media [77,87].

Violation of the Kramers-Kronig relation for the active laser materials [78].

Non-equivalence of the van der Vaals potential to the index of refraction in paraxial atom optics [79,80].

Proportional increase of the power of a disk laser at the increase of of the size of the active element [81].

The immanent impossibility of the analytic extension of the tetration [82].

The square root of factorial (which had been declared to have no sense) [83].

The inertioids (that violate the law of conservation of momentum) [7,96].

The author had participated in the discussions on very similar topics in various branches of physics. The common feature of these cases is, that the colleagues do not specify the range of validity of their concepts, do not indicate a way to refute their concepts, do not show the relations with previous results, and sometimes discuss applications of some effect without to indicate the contradictions with the scientific facts, with already commonly-accepted concepts.

In principle, there is nothing wrong in the contradiction of some experiments to some widely accepted theory. Contrary, such a revolutionary discovery is very interesting and important; it may indicate the need to revise, improve the most important concepts. However, such a contradiction is a main result of the research. Such a contradiction should be mentioned in the title, in the abstract, in the conclusion as the main achievement of the author.

For example, if the authors found violation of rules of arithmetics, the title of the article should cry: **The internal contradiction in axioms of arithmetics**. But the title of a scientific publication about such a revolutionary discovery should not mention the application for recovery of agriculture (destroyed by genocide, extermination of farmers), nor making the 5-year plan of production of metal in 4 years.

12. EXAMPLES

For illustration of the basic idea expressed above, I consider two last examples from the previous section. The examples of the concepts that, from my point of view, are not scientific. One of them deals with the effective dross-sections of emission in the laser material, and another one is so-called the “global warming".

One example of a non-scientific concept is shown in left hand side of Fig. 6. It is figure from Appl.Phys.Lett. [88], and it shows the effective cross-sections for the Yb doped Gd2SiO5 crystal. However, the curves for $\sigma_{absoption}$ and $\sigma_{emission}$, shown in the picture, contradict the McCumber relation. Such a contradiction leads to violation of the Second Low of thermodynamics. With such a crystal, one would be able to arrange the Perpetual Motion machine. The Second Law of thermodynamics is scientific fact, no experiments that break it is reported. The methodically correct would be claim of tremendous discovery, that causes revision of the most fundamental physical concepts. Instead, the authors claim the efficient laser material. Such a claim contradicts the 5th of the TORI Axioms (Principle of correspondence) [85] and makes the concept non-scientific, according to the definition suggested. (However, it may still be considered as “scientific" in other system of notations, that make no difference between science and religion).

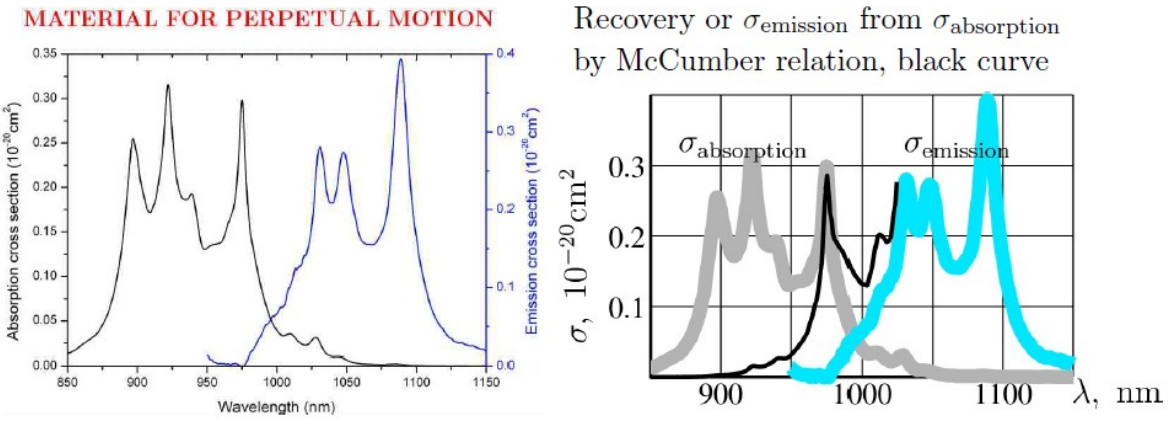


Fig. 6. Example of a fake result [88], left, and the “minimal" correction [84]

Perhaps, both curves for the cross-sections in left plot of Fig. 6 are wrong. The hypothesis, that the only $\sigma_{emission}$ is wrong, is considered; then, $\sigma_{emission}$ can be recovered from the $\sigma_{absoption}$. Such a recovery, correction [84] is shown in the right hand side of Fig. 6 with black curve. (This curve is not extended to the right hand side of the plot: there, values of $\sigma_{absoption}$ are small, and the error of the recovery is huge.)

The wrong effective cross-section mentioned cannot be interpreted as occasional mistake of a single researcher. A dozen of researchers published similar curves in various scientific journals: Appl.Phys.Lett. [88], Optics Express [89] and Solid State Comm. [90]. In such a way, the error should be qualified as methodological: the results were not revised from point of view of **self-consistency** (Axiom S4) **principle of correspondence** (Axiom S5).

Contradiction of results to the McCumber relation (and therefore to the Second Law of thermodynamics) should be revealed and declared by the authors before it is found by the reviewers and other colleagues.

On the first glance, the left hand side of Fig. 5, if we remove words "MATERIAL FOR PERPETUAL MOTION", looks more scientific, than Fig. 1 (that explains the basic principle of propulsion of the Russian satellite Yubileiny [91] and other intertioids, developed at the Russian Cosmic center). However, if we look at the meaning of quantities plotted as ordinates, we see, that the difference is not so big: in both cases, the fundamental laws of physics are broken.

The similarity goes further. In both cases, the inventors, instead of to claim, that the basic physical concepts should be revised, just declare, that their invention can be useful. Such a statement looks similar to the claims of organizers of a financial pyramid: they promise dividends to all the participants, and do not care about law of conservation of money. Apparently, the laws of arithmetic in their calculus are broken.

Another example refers to the global warming. Since year 2019, this concept is associated with name of **Greta Thunberg** [92] shown in Fig. 7. Several links on this concept are collected at Citizendium [96] and Mizugadro [86]. The common fault of the adepts of the global warming is, that no way to reject this concept is found in the bunch of literature on the topic. From the first glance, the absence of snow during summer at Europe (say, at the latitude of Peterburg) and absence of snow anytime of year at the Japan latitude (say, at the level of Tokyo) was supposed to confirm the concept; and the presence of precipitation of water in solid state (in the conditions mentioned) should negate the concept. This happened to be not a case: after the heavy snow at Tokyo area 2013.01.14 [94] and at Peterburg 2017.07.22 [95], the adepts of the global warming still keep their claims.

Since that, it is not possible to consider the global warming as a scientific concept: The adepts of that concept do not specify, which observation would be sufficient to refute it.

Fig. 7. G. Thunberg 2019 [93]; Honshu 2013.01.14 [94]; Peterburg 2017.07.22 [95]

In order to help the adepts of the global warming, an exaggerated example of such an observation is described below.

Assume, during century 21, all the seas, even in the tropical zone, happen to be covered with layer of ice. Then, one should admit, that the concept “global waring" is just wrong.

Up to year 2020, neither this, nor other (more soft) observation, that could refute the global warming, is detected in the literature.

On the base of this result, the global warming is qualified as non-refutable concept. It does not satisfy axiom S3 (**Refutability**) and, by this reason, cannot be cannot be considered by scientific methods.

However, the behavior of adepts of the global warming can be subject of scientific research. The avoiding or verifiability and refutability (basic principles of the scientific knowledge) can be qualified as a custom, making analogy with other customs; for example, with that shown in Fig. 2: There is some similarities in poses of two persons, shown, but this similarity does not go farer.

Such a mimicry not rare in the human history: Activity of so-called “Liberal Democratic Party of Russia" has nothing to do with liberalism, nor with democracy. Use of service of a prostitute has

nothing to do with reproduction of the mankind. The visit of a fat oligarch to a high-ranking restaurant has nothing to do with the nutrition of his body.

Even the clans of Red Rose (Lancaster's) and White Rose (York's) [97] have nothing to do with gardening.

In the similar way, the near-scientific activity of researchers and politicians, who do not care about scientific meaning of their concepts, has nothing to do with making of science; it is just money laundering. The TORI axioms are suggested to reveal and qualify such a kind of activity.

It is difficult to write a separate erratum or article on each case; only few popular mistakes are mentioned in the publications cited. I suggest to adjust the criteria that the scientific results are supposed to satisfy. This does not mean to make the requirements harder, but to soften the struggle between the authors and reviewers, that sometimes takes the strange form: the authors try to hide the cases when the concept fails while the reviewers are supposed to reveal these cases. In particular, the criterion S1 strongly suggests that the researchers estimate, until where their concepts are valid. In the similar way, the criterion S3 invites the authors to indicate, which result of which experiment would indicate that they are wrong. Such indications and estimates greatly simplify the refutation of concepts, making them scientific.

This approach will help to deal with strange phenomena like observation of the "torsion fields" or the "cold nuclear fusion"; either to reveal the error of the concept at very early stage or to turn the research into the scientific methods, making them different from a circus trick. The definition of science suggested should allow this without to struggle against pseudoscience; such a struggle is dangerous for the science, especially in the countries where the abilities to the critical analysis were persecuted.

13. TECHNOLOGIES

Technologies are so important as sciences. Technologies are older than sciences.
First, Homo Habilis, and then - Homo Sapiens.

Technologies are can be qualified as customs, but they are close to both sciences and arts. On the one hand, technology uses the scientific achievements (and in this sense is close to science). On the second hand, any good technological solution is product of art. The margin between science and technology is determined by the definition of Science. Technologies have no need to demonstrate the evidences nor correctness of their concepts; the proof of technology is the efficiency in business, or, better, the efficiency of a new device. (It is conceivable to have good business with a device, that does not fulfill its utility.) The intents to boost the technology with governmental support are not efficient; they boost the pseudo-science, money laundering and other kinds the corruption. I consider the governmental foundation of technologies as fraud.

The classification of the human abilities and the analysis of the foundation of technologies falls out from the scope of this article and may be subject for the independent research.

14. DISCUSSION

In this Chapter, I suggest examples, that show, that namely the TORI Axioms S1-S6 are essential for the efficient building-up the scientific knowledge. I explain, how and why do I distinguish it from other kinds of knowledge.

In certain sense, this is question of terminology. One may insist on the old, "Newtonian" interpretation of science as a "true" knowledge, that does not need any hypothesis nor refutations. Then, the new term is necessary to denote the phenomenon, that is denoted with word "science" in this paper and in publications by Karl Popper.

I support, justify the need of the TORI Axioms with analysis of the observations, presented in the list of references below. This is not fully correct: this analysis is, by itself, based on the TORI

Axioms. It is unavoidable: one cannot consider the Aristotle logics (Boolean algebra) using the *motivated arguing*, (it is politically-correct equivalent of so-called “Female logics" [99]), as it would not be correct to describe the *motivated arguing* (Female logics), using the Aristotle logics.

In such a way, I cannot prove anything to the people, who do not accept the TORI Axioms, but insist on some “objective knowledge" instead. Nothing can be proven to a person, who negates the basic principles. In this sense, the TORI Axioms can be considered a religion. I consider this religion to be extremely efficient in building-up the scientific knowledge - in the similar way, as Muslims consider Islam as the most efficient way to heaven, as the Soviet veterans consider Sovetism as the most efficient way to built-up the heaven ("communism") for themselves (even if they have to convert their country to concentration camp in order to achieve this goal) [98]. In such a way, the TORI Axioms can be considered as a religion - in the similar way, as Buddhism, Judaism, Cristianity, Marxism and Islam.

The readers may consider the TORI Axioms as hypothesis, and compare the efficiency of this hypothesis with other models. I admit: perhaps, the other models are more efficient in obtaining the huge grants for the scientific (and not so scientific) project. Perhaps, for getting foundation, the motivated arguing [99] is more efficient.
Here I do not discuss, is this good or bad; I only analyze the observed phenomena.

One may consider also any alternatives, what should be called “science", and what should not. Provide your definition of term “science", and compare its efficiency to that I named.

If you use another definition, have you revealed, that the bzz by Valery Menshikov about “Yubileiny" and “Gravitsapa" are just fraud, money laundering, analogy of the Baron Munchausen’s claims (Fig. 1)?
With your definition, have you revealed, that the material with effective emission and absorption cross-sections, shown in left hand side of Fig. 6, violates not only McCumber relation, but also the Second Law of Thermodynamics?

Or anything else? Can you suggest an example, when your definition allows to reveal a fraud, and the TORI Axiom to not?

Or any example, when the TORI Axioms disqualify some scientific result, that gives a good profit for the Humanity?

Or anything similar comparison?

15. CONCLUSIONS

The strict definition of science with criteria S1-S6 (TORI Axioms) is suggested. These criteria are based on the idea of *falisibiability* developed by K. Popper [8,9,10]. Terms *falsification*, *falisifiability* cause confusions; in particular, they disproves the Russian concept of history [68,69]. This problem may come to other sciences, for example, into physics. To avoid confusions, Term *refutability* is better.

According to the definition above, the scientific results should include all the properties S1-S6.

Recognition of these six conditions as compulsory is necessary to save physics and other sciences from profanation.

I suggest that all the civil organizations and the courts consider as fraud any governmental foundation of any research that does not satisfy the criteria S1-S6.

I suggest that the editorials of the scientific books and journals and the chairs of the scientific seminars accept S1-S6 as the main requirements for the scientific results.

This applies not only to Russia, but to all countries.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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2. https://www.globalsecurity.org/space/library/news/2005/ space-050329-rianovosti01.htm Andrei Kislyakov. Russia to help to develop nuclear-powered spacecraft. 2005.08.01. RUSSIA TO HELP DEVELOP NUCLEAR-POWERED SPACECRAFT// RIA Novosti// MOSCOW. (RIA Novosti political commentator Andrei KISLYAKOV)// Russia that has developed state-of-the-art rocket engines is ready to use them within the framework of the international space program. Consequently, Russia is quite eager to explore deep space with the rest of the world. // In Moscow's opinion, such is the gist of international accords that were approved by 21 countries and 15 international organizations in the United States late this March. The concerned parties discussed interplanetary space-fiight plans that were suggested by national space agencies. A document would be expected to formalize the discussion's results by August 2005.// Russia suggests that those involved in the Martian program use its nuclear rocket engines and propulsion units, Academician Nikolai Ponomarev-Stepnoi, vice-president of the Kurchatov Institute national research center, noted in early March. He made this statement at an international conference in Moscow that discussed nuclear-powered spacecraft.// We would develop such an engine and propulsion unit by 2017, if the relevant international decision was adopted today, Vladimir Smetannikov, chief designer of the Dollezhal R&D institute, believes. Consequently, it would be possible to launch a manned space ship toward Mars by that time.// According to Ponomarev-Stepnoi, the world's countries understand that long-range space ights are impossible without nuclear propulsion units. Incidentally, nuclear engines can be used to accelerate spacecraft, also serving as their power-supply systems.// It should be mentioned in this connection that the Energomash science-and-production association (NPO) had developed the first Russian nuclear rocket engine back in 1981. However, its comprehensive tests never took place because of tougher nuclear environmental-safety requirements in space research. The United States also conducted similar experiments, failing to test even a prototype version. // Nonetheless, theoretically nuclear-powered rocket engines cannot be called something entirely new. For its own part, the R&D institute of space systems near Moscow is busy developing a perpetuum mobile (perpetual-motion engine), of sorts. This engine that will have a virtually unlimited service life could be used on Earth and in outer space. // Our institute's staffers have been developing a non-jet propulsion unit for several years in a row, Valery Menshikov, who heads this institute, said in mid-March. A liquid or solid-state propulsive mass moves along a preset tornado-shaped trajectory inside this engine, thereby ensuring sustainable propulsion. Quite possibly, we are witnessing a hitherto unknown interaction between the propulsive mass and little-studied fields, including the gravitation field, Menshikov explained.
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Segreti del XXI secolo: Roscosmos condusse esperimenti con Gravitsappoy? 11 settembre 2012. Yuri Danshov, Capo del Dipartimento dell'Istituto di ricerca per i sistemi spaziali: // "Si noti che non ci sono viti o remi. Diciamo che la trazione sembra dovuta al lavoro del dispositivo stesso ". "Se questo dispositivo fosse nello spazio esterno, cioe nel vuoto, a gravit zero, accelererebbe inde nitamente. All'in nito. "Ci sono nomi diversi, ma io chiamo "Gravitsappoy"". / guarda il video come N2 / // Stranamente, Valery Menshikov (direttore dell'Istituto di ricerca di sistemi spaziali, generale in pensione in pensione), che in precedenza aveva trattato lo spazio, non ha smentito le "idee" dei suoi colleghi, ma ha anche fortemente sostenuto.// Scienza u ciale non ha riconosciuto ne il lavoro del laboratorio vicino a Mosca, ne la teoria dell'antigravit dello scienziato Shipov collegato ad esso. ..
92. https://www.youtube.com/watch?v=TMrtLsQbaok Greta Thunberg to world leaders: 'How dare you? You have stolen my dreams and my childhood'. Sep 23, 2019. Guardian News // 'You have stolen my dreams and my childhood with your empty words,' climate activist Greta Thunberg has told world leaders at the 2019 UN climate action summit in New York. In an emotionally charged speech, she accused them of ignoring the science behind the climate crisis, saying: 'We are in the beginning of a mass extinction and all you can talk about is money and fairy tales of eternal economic growth - how dare you!'
93. https://www.businessinsider.com/viral-video-greta-thunberg-speech-death-metal-2019-9
A viral video remixed Greta Thunberg's UN speech as Swedish death metal. She said she'll 'be doing death metal only' from now on. Morgan McFall-Johnsen. Sep 30, 2019, 6:24 PM.
94. heavy snow at Tokyo region, 2013.01.14
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95. Heavy snow at Peterburg 2017.07.22
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96. http://en.citizendium.org/wiki/Reactionless_propulsion .. technological concept of an engine that moves a spacecraft without using any external body to push from, and without jettisoning any of its parts.
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throne, the wars were named many years afterward from the supposed badges of the contending parties: the white rose of York and the red rose of Lancaster.
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DISCLAIMER
This chapter compile some results described earlier in articles published by the same author(s) in the following journals.
Place of science and physics in the human knowledge. Physics-Uspekhi, v.181, Trubune, p.1-9, 2010-2011 (in Russian)
TORI Axioms and the Application in Physics. Journal of Modern Physics, 4(9): 1151-1156, 2013.
Broadband laser materials and the McCumber relation. Chinese Optics Letters, 5: S240-S242, 2007.

Reviewer’s information:

Preface: several corrections by the Reviewer 1 are minor (for example, misprints) and introduced into text at the Galley proof. But some of notes by Reviewer 1 could not be taken into account so easily; they are copypasted below.

End of section 2: Where does love enter in these four classification?
Authors reply: Love is custom. The flowers of love are difficult to grow-up at the background of hate, slavery, sadism and tyranny. Love is difficult for the scientific analysis. So, it is not mentioned.

About section 6: I do not think Buddhists consider Buddha as God.
Authors reply: It does not matter. Big statues of Buddha are the proof.
Lenin, Stalin, Hitler, Molotov and Ribbentrop also did not consider themselves as fascists. However, the numbers of victims the national and international socialisms greatly exceed the number of victims of regimen by Benito Mussolini, who had declared himself as fascist.

More about section 6: However omnipotent as she is, God cannot cancel something that already happened. So, Sovietism is not a religion.
Authors reply: The 'Big Brother' and his accomplices in Utopia "1984" do not declare themselves as religious adepts, but the alteration of the past is namely that they are doing constantly. The "ministry of Truth" is dedicated to canceling of things that already happened. Similar phenomena take place in the USSR, in Russia, North Korea and China. (By the way, several authors, who had published

the wrong results mentioned, have affiliation at institutes of China; Marxism is official religion there.)

About end of section 7: The sentence “Before quantum ...” would need justification or a references, over-vice, im might be considered as pseudo-science.
Authors reply: Thanks for the note! The statement about entry of mathematics to other sciences id rewritten and supplied with references. 100 and 101.

About section 12: Here, we talk about global warming, so, any "local" event cannot refute the concept. If we look at the global indicators: level of sea water, amount of CO2 in the atmosphere averaged over the planet, then the evidence of global warming becomes very strong.
Authors reply: I saw many publications about global warming. None of them refers to a site, where the data about sea level in various places (that could help to confirm or to negate the concept) are available in a free access.

More about section 12: It is easy to show that global warming is a fact: just look at the time series of the Earth's temperature over the last 40 years. It is increasing year after year. If the Earth's global temperature next year, and in two years, etc., then this will be a refutation. Easy.
Authors reply: 40 years, it is too short interval for the climatic activities. A. Pushkin gives an example, when, in the Peterburg region, the rains continued until the end of year, and only in January, the precipitation changed from water to snow. That happened 2 hundreds year ago. There are many such historic evidences. But I see no collections of these evidences in the literature about the global warming. And, again, the adepts of the Global Warming do not provide links to the sites, where the temperature data are available. They do not indicate, which “optimistic“ models (that do not imply a global catastrophe) were used to fit the data; no estimate of the statistical significance of rejection of these models is found.

More about section 12: It seems you are going wayward here.
Authors reply: Yes. As usually.

About section 13: This is debatable. I would say, science is more important than technology.
Authors reply: Society with science without technology is described at “Gulliver's Travels” by Jonathan Swift, Part 3, Chapter 2.
Thanks to Reviewer 1 for the good job about this article!