

# **Substantial temporology and paradigms of natural sciences**

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## **1. The problems of natural sciences admitting temporal comprehension**

Purpose of given article is to present point of view which postulates that a lot of problems of natural sciences admitting temporal comprehension, requires for their solution withdrawal outside the limits of paradigm existing in modern science. Among such problems (Levich, 1993; Levich, 1995a):

- Origin of becoming, or "flow" of time.
- Origin of mechanisms of modifications beginning and outcome of new in the World.
- Necessity of overcoming of inconsistency between obvious difference of the past from the future in the world of real processes and reversibility of time in fundamental physics laws.
- Necessity of overcoming of inconsistency between requirement of fulfillment of thermodynamics second law in the closed Universe and absence of visible traces of degradation in it.
- Absence of conventional paths of fundamental equations of "generalized motion" derivation (instead of guessing) in various science areas. (I'd like to notice that equations of motion themselves represent the description of researched object variability with the aid of some standard variability, or clocks, so that choice of clocks which are adequate to research subject decisively affects the form of equations to be found).
- Necessity of both unified description of specific times in natural sciences (physical, biological, psychological, geological etc.) and recovering of time universal status.

- Necessity of adequate measurement of own age of the most broad spectrum of natural systems and dreams about realization of the approaches to "management" of their own time.
- Difficulties relating to scientific prediction.

I'd like to enumerate some features of existing scientific paradigm. Apparently, withdrawal outside it is necessary for temporal comprehension of natural sciences problems:

- Time is studied by philosophy, not by natural sciences.
- Time in a science is initial and undefined notion.
- For measurement of time physical clocks based on gravitational or electromagnetic processes are sufficient.
- The problems of time in natural sciences are solved or unsolved problems of relativity theory.
- Our Universe is isolated system.
- In conceptual arsenal of science there is no place for substations of such types as phlogiston, light-carried ether, entelechia...

## **2. The problems of time become the problems of natural sciences**

In present century in natural sciences the attitude to ideas about time has changed — they has been transformed from means of solution of narrow special problems into object of research. For a long period of natural sciences development researchers did not study the problems of time, as such. However, it was often appeared (and it's very important observation for us) that the most difficult problems of natural sciences required the revision of knowledge of time for their solution. I'd like to illustrate these ideas by several examples which can be considered as milestones in the study of time.

## *Is time reversible or not?*

Ludwig Boltzmann (Boltzmann, 1872) was solving the problem of substantiation of the macroscopic equations of statistical physics with the aid of fundamental equations of microparticles mechanical motion. The difficulty of this problem solution appeared to be connected with difference in a behavior of the equations when time is reversing. The equations of statistical physics do not suppose transformation of inversion of time coordinate. At the same time the equations of mechanical motion appear to be invariant to such transformations. Thus, the task about relationship of various equations classes was reduced to the problem: whether time in physical interactions is reversible?

## *Langeven's clocks*

There was a problem for Albert Einstein (Einstein, 1905) to coordinate the law of addition of velocities in classical mechanics with phenomena with participation of propagation of light. For the solution of this problem necessary (and sufficient!) conditions was to update operational procedure of determination of simultaneity of events which are distant from each other. To this purpose, scientific custom was replenished by new type of clocks — "Light clocks", or Langeven's clocks, based on properties of electromagnetic interaction as differentiated from astronomical clocks, accepted in those times, which represent standardized motion obliged to gravitation forces. The indicated clarification in time knowledge was enough for birth of new World model (four-dimensional World of Minkowski) and relativity theory based on it. There was "space conversion" of time, i. e. loss of free status by a time coordinate.

Due to successes of relativity theory there was conviction that all resolved or unresolved problems of time are problems of relativity theory (Hawking, 1988).

However, in relativity theory (as well as in all modern science) there is no point of view concerning "nature of time", understood as existence of origin of new mechanisms and sources of modifications in the World. (In pre-science or off-science knowledge the role of such mechanisms was assigned to demiurg whose competence included both creation of objects and reversals of their fortune.) The static vision of the World has become stronger: events don't

arise; the past, the present and the future of objects coexist in four-dimension world; "flow of time" is subjective sensation of observer, whose "ray of consciousness" "highlights" "area of the present" in the world lines.

### *"Stream of time"*

In the middle of present century astronomer from Pulkovo (Leningrad region) Nicolay Kozyrev studied physical problem of origin of stars power sources. By his accounts, traditional thermonuclear power sources are not enough for explanation of star luminosity. Speculations about possible additional power sources, and also various non-equilibrium processes observations have led N.Kozyrev to the hypothesis about existence of some new physical essence which coincide neither with substance, nor with space, nor with field as they are understood usually. Author named this essence as "stream of time" (Kozyrev, 1991).

In the N.Kozyrev' s concept it is possible to select some aspects adding one another (On the Way..., 1996):

- The statement about an openness of the Universe in relation to energy of "stream of time". As a consequence, this stream is one of power sources for astronomical objects and reason of infringement of the second law of thermodynamics in the Universe scale.
- The statement about a stream as some "carrier" which is necessary for "transformations from causes into effects", i. e. Kozyrev' s stream appears to be the source of beginning of new in the World.
- The statement about "radiation" or "absorption" of the stream by any non-equilibrium process and about influence of the stream on many objects properties — module of elasticity, weight, thermal conduction, density, resistance to electric current, electrons output at photoeffect, volume etc.
- The statement about force nonclassical influence of the stream on rotating objects.
- The statement about transferring of an information by this stream about the present, past and future (!) location of star objects.

If the first and the second statements at the present stage are unverifiable symbols of faith of the developed approach, then the experimental testing of other postulates required

decades of efforts of N.Kozyrev and his colleagues, followers and independent researchers. A number of the authors (Kozyrev, 1991; Hayasaka, Takeuchi, 1989; Qwinn, Picard, 1990; Lavrentiev et al., 1990a, b; 1991; 1992) discover effects to be found, other authors (Faller et al., 1990; Nitschke, Wilmarth, 1990; Barashenkov, 1996; Chigarev, 1996; Parchomov, 1996) either don' t find out the effects completely, or, sequentially excepting the possible causes of errors, prove that existing effects can be completely explained by traditional physical causes — electrostatic or magnetic weak influence; electromagnetic, particularly, heat radiation; mechanical resonance or nonlinear phenomena; convective heat exchange; radiometric operation caused by reflection of gas molecules with a greater velocity from a warmer side of details of measuring instruments. It is necessary to add, that perception and inclusive discussion of N.Kozyrev' s results are blocked also by absence of precise methodological study of logic frame of the concept, inconsistency of ideas about "stream of time" with conceptual apparatus, methods of theoretical analysis and the World picture in modern natural sciences, that is infringement of correspondence principle.

In relation to time problems it is necessary to select methodological aspect of the disputable N.Kozyrev' s theory: after his works time has ceased to be a subject of only philosophical research, however, it was necessary for this to postulate an openness of the Universe and to introduce the non-identified physical essence (substance), which could be reference of the time phenomenon in nature.

Cosmophysical origin of "Kozyrev' s stream" has something in common with substantial (by their nature) causes of influence of "passionate energy" on "historical time" of ethnoses (Gumilyov, 1990) (thereby as if "bridge" is building between time of nature and time of society) and with the same cosmogonic nature of phenomenon of conditions discreteness in a course of fluctuations in macroscopic processes of different nature (Shnol et al., 1998).

***Not time, but times***

To second half of the present century it has become clear that researchers deal not with time, but with times. There were numerous publications about biological, geological, psychological, social and other times relating the very different disciplines of natural and humanitarian cycles. The number of publications about time in many disciplines grows exponentially, with the same intensity the number of scientific conferences, symposia, seminars devoted to study of time grows.

From my point of view, one of essential reasons of increasing experts' interest to time aspects of their subject domains is comprehension of the idea, that the clocks measuring variability of researching objects can be different. Clocks are not only physical processes based on action of gravitation forces or electromagnetic atomic radiation. They are also biological clocks — processes of respiration, cell division, growth of organisms, change of generations or species... They are geological annals, processes occurring in mentality, society, history... Main thing which helps to differ the types of possible clocks is uniformity of their course (Levich, 1989, 1995b). More strictly, time intervals appearing equal while measuring them by one clocks, become unequal when other clocks are used. The point is that we are deprived of free mobility in time, which is similar to our transition in space; we can't by seizing current minute compare it with past minute. For each type of clocks convention acts (often implicitly), defining, what time intervals are accepted as equal. For example, for astronomical clocks all cycles of the Earth turn around the Sun are accepted as identical. At replacement of astronomical for cesium standard (observing the agreement about stability of its frequency) the astronomical periods become non-constant. Physical, and, for example, biological or geological clocks differ more strongly by uniformity of course.

Natural motive of application of non-traditional (nonphysical) methods of time measurement at the study of nonphysical objects is a hope (occasionally not unfounded, see Dettlaff, 1995) to detect the laws of a variability of these objects, or their "equations of motion". Construction of the equations of natural systems dynamics remains one of the primal problems of scientific research. The generalized systems motion, complicated and confused at the description with the aid of physical clocks, can appear to be simple and regular at the description in terms of specific time which is adequate to the nature of system.

However, all individual studies meet generally methodological difficulties: vagueness and weak development of ideas about time generally, absence of adequate language and conventional images for expression of intuitive ideas about time, which are usual for disciplinary experts, in modern science, absence of empirical frames and developed conceptual means for the study of time.

Conventionality of clocks is realized rather a long time ago by scientific methodologists (Poincare, 1898; Milne, 1948), but only during the last decades the decisive importance of such convention was reflected by natural scientists.

### ***"Forgotten dimension of physics "***

During the last decades of the present century the reflection of natural scientists relating to problems of time as themselves was exhibited especially clearly. Time more strongly converses from object of philosophical knowledge into object of natural sciences. In a modification of the status of ideas about time apologetic activity of Ilya Prigogine has played the main role. By naming time as "forgotten dimension of physics", he has devoted decades of his work to development and popularization of problem of time reversibility unresolved by L.Boltzmann (Prigogine, 1980; Prigogine & Stengers, 1984; 1994).

I'd like to emphasize the important aspect in the solution of problem offered by I.Prigogine' s school. Irreversibility is a result of motion instability. In open nonlinear systems the bifurcations are inevitable. Because of them trajectories of motion are irreversible. But stable motion also can be irreversible, however, openness of irreversible systems remains as obligatory condition. Namely, I.Prigogine gives an example of the equations of general relativity theory, in which the terms are added describing "outcome of a substance from space-time " in the form of particles with Planck masses (Prigogine et al., 1984; Prigogine & Stengers, 1994). The availability of such outcome supplemented by the interdiction for opposite process (transformation of particles into energy of gravitation) assigns, by I.Prigogine, "arrow of time" in our World. Let' s remark, that the models including birth of substance are actively discussed in cosmology (Bondi, 1960; Hoyle et al., 1993).

## *Relation or substance?*

I'd like to emphasize one more tendency of present natural sciences, which erodes existing scientific paradigm. This tendency is revival of substantial views in the last decades science. A circle of substantial ideas exploiting active properties of physical vacuum is especially wide. The set of scalar, vector and tensor fields offered for explanation of the phenomena of cosmology, physics of elementary particles, biology, mentality, communications and having pretensions to ontological existence is multiplied. I'd like to remind also about conceptually substantial approaches of N.Kozyrev, L.Gumilyov, I.Prigogine, which just were mentioned in preceding sections. And now we are dealing not with a verity of the similar approaches, but with the observable tendency in a choice of conceptual means for the World description (no matter whether we like them or not).

The history of natural sciences demonstrates regular change of substantial explanations by relational ones, or natural reduction of conceptual essences (V.V.Aristov paid attention to it). The ideas about phlogiston was substituted by the molecular-kinetic theory of substance, converting heat from substation into relation. The ideas about elastic light-carried ether were replaced by concept of electromagnetic field. Searching for the «essences of life" preferences are given not to Aristotle' s entelechia, but achievements of molecular biology. But, if the example of refusal from phlogiston is completely convincing, then the refusal from ether has required an introduction of other essences: boson form of a substance as carrier of interactions and concept of physical vacuum as material reference of physical space. As for nature of the alive, molecular biology has not yet achieved here sufficient depth of explanation (however, also there are no theories opening a nature of "vital force" named entelechia). So that the choice between relational and substantial approaches in particular can be determined by choice of a faith in necessity or untimeliness of introduction of new ontological essences into conceptual apparatus.

With the appearance of relativity theory relational paradigm has become conventional. Describing revival of substantial views is original response to long paradigmal domination of relational views. However, as a rule, the case in point is not returning, for example, to elastic

light-carried ether of 19th century. Here the case in point is searching for a physical structure of space and fields. The legitimacy of such searching is best illustrated by the views of A.Einstein himself: "to deny ether ultimately means to accept, that the empty space has not any physical properties. The main facts of mechanics is not agreed with such views... The general relativity theory endows space with physical properties; thus, in this sense the ether exists. According to general relativity theory, space is impossible without ether; really, in such space not only the distribution of light would be impossible, but also there would be no spatial-time distances in a physical sense of word. However, this ether cannot be imagined as consisting of parts, traced in time; such property is inherent only in weighable substance; also concepts of motion couldn't be applied to it" (Einstein, 1920).

Natural scientific problem of choice between relational and substantial approaches in description of space structures, fields, substance particles finds its sources in the existence of relational and substantial time concepts (Moltchanov, 1977). However, on this way mutual addition of relational and substantial concepts rather than their mutual opposition is supposed presumably as more fruitful (Levich, 1998).

Really, in modern substantial concepts substance is not time itself. It is only natural reference of time concept. "Flow" of time is identified with process existing in nature, or, in other words, this process is accepted as the measurement standard of variability, as original frame of reference for fixing modifications in the World. The same standard process parametrizes modifications of other objects, i.e. it is used as main argument for all varying functional relationships in the World, or it plays a role of parametrical time. The indicated identification just allows to consider substantial time (in the same degree like its reference) as reality and phenomenon. In the relational approaches there is no identification of time with any material essence. The relational time is speculative construction consisting of characteristics of material objects, i.e. it is the convention and noumenon.

Nevertheless, "there is no relation without substance", i.e. any relational approach uses total combination of material objects for creation of relationships between them and construction of time on the base of these relationships.

Thus, being lifted on high philosophical generalization, it is possible to make a conclusion that both in substantial and relational approaches time is motion of substance. In

the substantial approaches motion carriers are stressed, but in relational ones motion as itself, or, if it is necessary, certain relationship between elements of substance (motion can be considered as one of these elements) are stressed. But both there are no relationships without their carrier, and the substance without motion does not generate a variability. It is important to emphasize, that in substantial approaches, as a rule, the case in point is ordered motion, i. e. stream (not in a sense of availability of a chosen direction in some space, but in a sense of amount of substance increase near its source). In the relational approaches any ordering is not postulated.

The existing practice of development of substantial and relational approaches unambiguously distinguishes the status of material essences, whose characteristics are identified (substantial approach) or correspond (relational approach) with time properties. For substantial approaches this is a certain "thin substance", not identified by modern scientific technologies. But in the relational approaches this is, for example, nucleons (Aristov, 1995), "macroscopic objects" (Vladimirov, 1995) and supermolecular constellations.

Thus, the difference of the considered approaches appears in nuances of initial postulates: in substantial approach substance and its ordered motion in the forms not identified by modern experimental technologies are postulated, in the relational approaches substance in known forms is postulated, but the ordering of motion is not mentioned. So, it is possible to notice, that the substantial and the relational approaches, introducing time through different types of various substance forms, make an addition to each other rather than opposition.

In their opposition there can be more important that substantial concepts gravitate to paradigm of the open World, and relational ones rely on the ideas about closed and isolated systems, but it is not even opposition "relation or substance".

### **3. Construction of time is needed**

On the path of effective application of ideas about time to problems of natural sciences and on the path of profound inclusion of time problems into own problems of natural sciences there is an obstacle more and more precisely realized by researchers. In modern science time is

initial and undefined notion. Therefore primal problem of both contributors of time and experts in different scientific fields is necessity of creation of an obvious time construction, or its model. In other words, the replacement of time in initial concepts by other basic postulates is necessary. After such replacement properties of time itself could be possible to formulate not as axioms, but as theorems of the deductive theory. The discussion of any time properties becomes possible only within the framework of its certain model.

It is necessary to notice, that the creation of time construction lies in the replacement (in axiomatic base of science) of time by other initial concepts or, in other words, in reworking of all base of conceptual tools. It is clear, that such reorganization inevitably affects a broad circle of basic concepts in natural sciences. Among them we can find out space, motion, matter, energy, interaction, charges, entropy, life... Thus, the case in point is not a private research, but it is necessary extensive and deep research program, and for its fulfillment efforts of several generations of researchers can be required. However, now in the mentioned problem the great thing is to comprehend that it exists. More than one century was required for such comprehension.

To understand "nature" of time means to indicate its natural reference, i. e. process, phenomenon, "carrier" in the material world, whose properties could be identified or corresponded to properties assigned to time phenomenon.

### ***Substitutional time of natural systems***

From existing models of time (On the Way..., 1995; Levich, 1998) I'd like to present illustrating example of substitutional construction (Levich, 1995b; Levich, 1995c).

Some principles and definitions are used as the basis of the construction. *Hierarchical principle*: all natural systems include a few levels of a hierarchical structure. *Principle of existence of generating flows*: any natural systems are not closed in relation to flows of elements of some levels in their hierarchical structure. The aggregate of elements from each generating streams is offered to be named substance. The notion of substance is extremely ambiguous both in natural sciences and in methodology of science. Substance is often comprehended as those essences, whose being status is different from the status of material

fermion particles, for example, space, field, physical vacuum ... In the context of problematic of works on time I offer to accept substance as a kind of matter, which is distinct from substrates represented by fermion particles, atoms, molecules. It is supposed, that this kind of matter belongs to deep levels of its structure. Possibly, it is not identified immediately by modern experimental technologies and maybe does not participate in known now types of interactions. *Construction of time course*: one of the levels of system hierarchical structure, which is a basement of generating flow existence, is selected as "time-forming", and appropriate generating flow is declared to be the natural reference of time course (it is meant that the *principle of conventionality* is admitted: choice of time-forming level depends on purposes of research). For open systems the idea about identification of time course with the flow of substance or energy, in relation to which the system is not isolated, becomes trivial. These flows generate modifications in the system and they also can be served for parametrization of own system variability, i. e. for the measurement its own time. Within the framework of accepted hypotheses it is possible to give the name "paradox of becoming" to reality, by virtue of which the time course is inherent not only to open systems, but also to systems, considered with a greater accuracy as isolated and closed ones. For example, anchor escapement mechanism with elastic pendulum (mechanical clocks), Solar system (astronomical clocks), Universe as a whole... For the settlement of "paradox of becoming" the above mentioned principle of generating flows existence implies that all systems, possessing the phenomenon of time, are open. *Construction of substitutional clocks*: an interval of substitutional time of a system is determined by an amount of replacements in the system (substitutions) of elements of generating stream intrinsic in its time-forming level. *Construction of charges*: let' s name sources or sinks of generating flows in our Universe as material particles. *Construction of space*: Space is generated by association of substances of generating flows intrinsic in some levels of systems structure, which is higher than time-forming level. *Construction of substitutional of motion*: any motion (any variability) of system lies in a replacement of elements which are its constituents at the certain structure level (*principle of variability*). And mechanical motion (in particular, for systems isolated by substance and energy) is described by a flow through moving system of elements of substance-medium. Hence, the "paradox of becoming" for mechanical systems is solved. I'd like to notice that

substitutional motion in space occurs not by "moving aside" of substance elements, but by "penetration" of elements into object and replacements of elements, just being available inside object, (i. e. "ether wind", "ether friction" don't exist, and substance of generating flows in the indicated sense is not "ether" of 19th century).

The model of substitutional time (not necessary explicitly) gives a lot of possibilities for theoretical description of the World:

- The phenomenon of becoming appears to be a re-formulation of the hypothesis about generating flows existence.
- "Arrow" of time arises naturally and the "paradox of time" is settled (Prigogine & Stengers, 1994), residing in an inconsistency between unconditional convertibility in time of fundamental physical laws and obvious difference between the past and the future in the world of real processes. The account of generating flows in the motion equations (Levich, 1995b) naturally results in their irreversibility (in the same degree of irreversibility, which inherent in flows themselves).
- Inconsistency between the second law of thermodynamics, acting in the closed Universe, and absence of degradation traces and inevitable motion to an equilibrium in the World is solved.
- The constructions of matter, charges, space, motion, interaction, etc. are introduced into consideration.
- A possibility of derivation and studying of the motion equations appears.
- A conceptual means for designing and discussion of such properties of substitutional time as system specific features, discreteness, nonuniformity of course, existence outtime events...
- By clear way entropian parametrization of system specific substitutional time, returning usual universality to time, arises.

Time in substitutional approach becomes a consequence of the Universe openness. The variability of the World is generated by substitution, "elapsing" through it, and "elapsing" as itself is identified with course of time. In this case the concept of generating flow unites the concept of matter (which particles are singularities of a flow), the concept of space (substances of a flow) and the concept of time (variability generated and parametrized by a flow). I'd like

to stress once again, that the substance is not a matter in the form of a substrate — complex of particles possessing charges and interactions. The substance generates these particles, their charges and interactions: "substrate" properties of particles appear to be dynamic characteristics of sources or sinks of substantial flow (their successful visual image is spring or fountain "spurted out" in a reservoir).

Various generating flows can generate both times distinguished from each other by "uniformity of a course" and distinguishing types of interactions.

### ***Getting rid of the bugaboo of thermal death***

It is necessary to mark a possibility to save all discussions on connection between substantial flows and phenomenon of time without demand of the Universe openness. For this purpose it is necessary to consider the flows as not generating, but as dissipative, i. e. resulting of fluctuations or some initial impulse without further supplement of a system as a whole by energy, substrata or substances. So, for example, within the framework of the model "Big bang" there are natural reference of time — cosmological (extension of the Universe or reduction of a substance density or cooling of relict radiation) and entropian (decrease of structuredness or degradation of the World). Dissipative and "generative" origins of substantial flows are equivalent to each other when time course is described, but are completely different in the terms of world outlook.

If one recognizes the generating flows, he thus removes the opposition between the second law of thermodynamics and the existence of development since the second law is valid only for isolated systems. The applicability of the second law to the open part of the Universe, where the generating flows create the course of time, is also avoided; however, this conclusion does not make a discovery for both physicists and astronomers: "...the everyday experience convinces us that the properties of nature have nothing in common with those of an equilibrium system, while the astronomical data show that the same is valid for the whole enormous part of the Universe available to our observations" (Landau and Lifshits, 1958). Moreover, "separate celestial bodies and their systems are so well isolated from each other that thermal death must noticeably approach them before any external system could interfere. Therefore degraded

states of systems ought to be predominating, whereas in practice they are nearly never observed. Thus the problem is not only to explain why the Universe as a whole is far from equilibrium, it has a much more concrete meaning: to gain an understanding why separate systems and even separate bodies continue to live despite their short relaxation times" (Kozyrev, 1963).

The entropy extremum principle applied to the Universe open to generating flows, drastically changes the view of world evolution. Here is the future of the Universe drawn by I.D.Novikov: "... If there are no appreciable amounts of matter, unobserved by some reasons, between the galaxies, then the Universe will expand forever.... In about hundred thousand billion years the very last stars will die out.... Despite the present-day absence of direct experimental data, the totality of our physical knowledge indicates that the matter of the Universe is unstable and, although very slowly, decays.... Black holes, the remaining after the death of some massive stars and also existing in the galactic cores, also evaporate due to quantum processes. Thus both the cooled stars and the dilute gas, and later the black holes, will disappear from the Universe in its remote future... and only rare electrons and positrons, spread over huge distances from each other, will remain".

The future of the world is described still more dramatically according to "the Helvetius principle" —“The time whose tooth chews up iron and pyramids, sees only the death which it brings" (Helvetius, 1907) by Yu.B.Moltchanov (1990): "...everything disappears in time, and disappears tracelessly, and that' s the true essence of time".

The generating flow hypothesis gives an opportunity to put forward, in contrast to the Helvetius principle, another one, worth calling "the Kozyrev principle" — "Evidently some possibilities of struggle against the thermal death must be contained in the most basic properties of matter, space and time, there must be processes opposite in direction, those which can be called the processes of life. Those are the processes which keep the eternal life of the Universe" (Kozyrev, 1963). As long as the Universe is open to generating flows, its evolution is accompanied by self-organization, increasing inhomogeneity and complexity.

### *On socialization of substantial ideas*

The development of the substantial approaches by virtue of experimental non-identification of substantions declaring in them meets many difficulties. It is possible to allocate two ways of socialization of substantial ideas. The most direct way is operational presentation, i.e. reproduced measurement of some characteristics of substantial flows, which are different from their main manifestation — our time course. We are on this way (using analogy from the history of electricity discovery) more likely in the position of Galvani's "frog dancemaster", than in the position of the owners of Faraday's frame coming to us till nowadays. It is necessary also to take into account that according to accepted here definition, the substance generating interaction of particles, nevertheless, does not interact with them. And, apparently, it is not necessary to complain of low development of substantial hypotheses: experimental detection of objects in the deepest levels of matter structure depends not only on intellectual theorists' gains, but in a huge degree on "sum of technologies" reached by the civilization (as S.Lem expressed). Vivid examples of justice of this statement are distance as big as thousands years between the atomic hypothesis of Democritus and experiments concerning diffusion of atoms and other experimental confirmations of the nuclear structure of substance, or distance the size of one hundred years between declared by Mendel particles of heredity and conducted by Watson and Crick x-ray structural analysis of DNA structure. Other way of socialization of substantial ideas is the speculative one, i. e. the way all the same "to invent hypotheses" and, basing on the introduced new essences, to work out consecutive theoretical construction of a consistent picture of the World, to explain known effects, to formulate predictions of new effects in experimentally accessible areas, and, the great thing, to try to decide existing problems of natural sciences with the aid of substantial approaches.

#### **4. Features of new paradigm**

The model, offered as an example, reflects the aspects, which are common for the whole class of substantial models seeking comprehension of time. Nowadays, in the end of passing century, which could be named as century of scientific progress, the features of new

scientific paradigm gradually appear, which probably will determine development of natural sciences in the beginning of third Millennium:

- It is possible to speak about the natural references of the time concept. The phenomenon of time can become equal object of natural sciences.
- Time of natural systems has a structure and can be an object of theoretical modelling.
- For further development of ideas about space, time, matter, motion and interaction in conceptual basement of natural sciences, some new essences, which most likely will emerge in the form of substantial approaches apparently, are deficient.
- Standard processes, which help to measure the variability of researching object, i. e. clocks, can have a completely various nature. The various clocks could be not co-steady, and descriptions of the motion laws, getting with their aid, could be not come to each other by means of simple transformations.
- Probably, the radical solution of problems of time course and irreversibility requires the refusal of existence of isolated systems and results in idea about open, nonlinear, self-organizing and, probably, becoming complicated World.

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