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The biophysical modelling of the compartmentation in the living systems

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Abstract
Biophysics, therefore, applies the methods of the physics. Those procedures, however, which are not comprehensive enough will be enlarged, in some cases indeed will be laid even on new physical basis making them liable to investigate some biological questions. Joshua Lederberg the Nobel-prize winner geneticist: „Biology is too important to be left just for the biologists." One side is meant the inner development of the biology which proceeds along a spiral line expanding evenly in breadth and depth offering thus an image truer to the nature. The other side implies the border sciences come to light from the biology out of which biophysics has got a very important role. The system theory has generalized this biologically interpreted compartmentization for the systems. The components of the systems may be arranged in groups according to spatial, temporal, structural and functional parameters and so you can obtain the compartments of the systems. According to this, if the order of information has reached the order of magnitude of the compartment then there's no reason for further compartmentization. In the case of enlargement and reduction of systems and compertments, respectively, experts' well acquitted method is the similarity- (comparative) and dimensional analysis. The professional terminology has named it renormative transformation. The major characteristics of the fundamental interactions are as follows: the time, the intensity, the range and the symmetry of interaction. As it is evident from the proceedings, the phase space of the systems capable for chaotic movement rather complicated: at the same time, it contains /includes the periodic movements found quite regular and those randomly confused.

Keywords: Systems, Compartmentization, Internetics

Introduction

We may observe that the new discoveries in physics almost always vigorously change our image established of the biological processes. Quantum-chemistry implied an immense progress in the recognition of the cohesive forces between molecules, creating internetics. Also, the study of the living world's phenomena contributed to the elaboration of the irreversible thermodynamics. Plenty of examples can be found for the temporal and spatial oscillation. The application of the recent results of the statistical physics and irreversible thermodynamics denotes significant progress in the understanding of the evolution of biological structures, besides in that of the origin of life.

If we raise the question in general – not in connection with a concrete problem – what biology needs of physics, it's true to say the least, almost everything which doesn't fall into the world of the extremely large energies, of the extremely large measures (dimensions) and terms [1]. Occasionally, some unexpected possibilities of application may arise and just these may offer you essentially new results. So, there is a lot of need, the thing is perhaps that in given circumstances certain territories enjoy preference.

In the course of time, physics has developed numerous measuring procedures, investigations, a vast number of devices serving for the study of different properties of the various materials. After a shorter-longer period of time, the new methods and the new apparatuses are being applied for the investigation of biological materials, too. As a topical example, you may again mention methods and tools related to the discovery of the structure of the matter.

The system

Every science has central questions such key issue in biophy¬sics is the model forming. For the model we understand a mathematical or physical construction (function, formula, interrelation) which describes the observed phenomena by adding certain verbal explanation. Such a physical construction will be exclusively and exactly justified if it is expected to work – i.e. properly describes phenomena in a rather wide range [2].

The obvious key issue is how single models cohere in what extent and in what way they can be related? If we rightly imagi¬ne that research is an answer-to-question game with the nature and the single disciplines, groups of problems are characterized by certain classes of questions, then it is evident that models originating from identical classes of question should be included in the same model-families. Moreover, if members of a model family can be transferred into each other unequivocally enough then we can speak about a theory-forming model system. It is the intention of the biophysics to elaborate model systems ever more unequivocal and of ever wider validity.

Biophysics, therefore, applies the methods of the physics. Those procedures, however, which are not comprehensive enough will be enlarged, in some cases indeed will be laid even on new physical basis making them liable to investigate some biological questions. On the track of its inner development numerous fields of the physics have been established which can be utilized in the physical analysis of the biological processes, which are discovered, taken over and applied by the biophysics [3]. By raising questions to be solved, the biology demarcates field of action for the biophysics this, on the other hand, contributes to the biology getting a more exact science.

This wide liberty of choosing axiom is yet limited in reality by the usefulness of the theory. On usefulness it is meant how the biophysical theory can be applied to the biology, i.e. how it helps in the alignment to sum up the results dispersed so far. The lesser observations or experimental results have been left over the estimation stacks deductable from the biophysical axiom systems the more exact the biology becomes to be. In this context our theoretical discernment should be stressed that as long as some important problem and elements will not be cleared on the level of the biology one cannot expect epoch-marking discoveries from the biological point of view. Hence the biologist must not wait idly that the biomathematics, biophysics, antropology, paleonto-logy should solve its essential problems. We have to agree in turn with Joshua Lederberg the Nobel-prize winner geneticist: „Biology is too important to be left just for the biologists" [4].

Considering the above said we may state that the exactness of the biology can be approached from two sides. One side is meant the inner development of the biology which proceeds along a spiral line expanding evenly in breadth and depth offering thus an image truer to the nature. The other side implies the border sciences come to light from the biology out of which biophysics has got a very important role [5]. All these are still in their „infancy", biology is going ripen for exactness but we are still at the beginning of the process. It is hoped that still in this century a quality leap in this direction shall come to pass so that we can affirm that in the future's axiomatic biology life will be a fundamental conception without being defined.

The Compartmentization

By compartmentation in the biology it is meant that the localization of some components of the metabolism (substrates, enzymes, coenzymes, stimulants and inhibitors) within the cell is identical in order to secure a harmonized co-operation, or on the contrary, if their localization within the cells is different it may make interactions impossible under normal circumstances. [6] Many times it enables a sudden state of reactivity another time even inversely. This principle prevails both in the cell and in the organelle and this is why metabolic reactions not always take place in vitro identical to those in vivo. The very same matter (e.g. metabolic product) may occur in different cell organs within the same cell so that its exchange between the different compartments is slow.

The system theory has generalized this biologically interpreted compartmentization for the systems. The components of the systems may be arranged in groups according to spatial, temporal, structural and functional parameters and so you can obtain the compartments of the systems. By dividing the systems into compartments, the modelling of the structure and function of a given system will be promoted [7]. Considering certain border conditions compartments enable us to constitute mathematical interrelations.

There is no sharp limit between compartments and the number of compartments can be increased or diminished by amplification and reduction, respectively. The ampli-fication/enlargement and reduction/diminution of the compartments depend on the researcher and the compartmentization is confined by Heisenberg's principle. According to this, if the order of information has reached the order of magnitude of the compartment then there's no reason for further compartmentization.

Enlargement and Reduction

It is an empirical fact that the construction of the matter shows certain hierarchic structure. The grades of this hierarchy are generally characterized by well separable distance-, time- and energy-scales. As a matter of fact, this kind of separation enables us to create in se more or less closed theories for the description of movements on certain levels of the hierarchy [8, 9].

Where is the point to limit the extensibility of rules for larger systems as controlled in the range of the excessive distance? Is there any way to find means whither the frames of experiences and that of the theoretical system to approach regularly and with scholarly character the alteration/modification or constancy of the natural laws during the change of the linear dimensions?

In the case of enlargement and reduction of systems and compertments, respectively, experts' well acquitted method is the similarity- (comparative) and dimensional analysis. The professional terminology has named it renormative transformation. The enlargement of compartments will be carried out technically with the help of microscopes, fieldglasses, telescopes but recently even computers are suitable for such operations. As far as the computer is concerned, enlargement can be conceived in a figurative sense, in the praxis we have the computer calculate far more points of intersection than before and these will be plotted in a larger scale system of co-ordinates lines.

A concrete system or compartment can be examined in its given state using different scale enlargement. Let's double, for example, the enlargement of an image identical to the reality, i.e. the distance of two points to be twofold. In the meantime, let's diminish the resolution e.g. to the half of it, i.e. the real distance within which points can be substituted by a single one should be doubled. By binary transformation we get a new image of the system which may be interconnected with another real state of the system [10]. Of course, it is essential by what objective change of quantities nature can bind the two states. With this knowledge the mathematical transformation can be only equalled to the structural reality of the system.

In the course of microscopic examination of the biological systems – irrespective of the kind of microscopic study – we proceed like mentioned above. In the biology not only, the enlargement will be used in examining living systems but the diminishing, too. We reproduce and examine recurrences taking place in the biosphere under laboratory dimensions. It was the diminishing to allow breakthrough in our knowledge relating the origin of life by producing the primary atmosphere of the Earth in flask.

In a given system the number of the compartments increases by enlargement and it decreases by diminishing. Both enlargement and diminishing is limited by the technical apparatus, the measurability and domains of the parameter and by the Heisenberg's postulate.

Internetics

There is a steady interaction between the material objects on the most different levels and in the most various forms. The interaction is a general concept which – like the system – shall not be defined. We try perhaps to explain, to circumscribe it which still, of course, is not a definition. Interactions are the concrete outward forms of the matter's existing mode. We know only the finite extension – in time and space alike – of the material universe and so we posses only limited knowledge concerning the possible outward forms and modes of the matter. But the types of the interactions will further increase, for sure, as a function of the scientific research and the knowledge of materials [11]. The internetics deals with the analysis of interactions, with the description of their characteristics.

The most different objects of the material world affect mutually each other. To our recent knowledge in physics and chemistry, the interactions of different type are attributable to four fundamental forms: gravitational, electromagnetic, weak and strong interactions (nuclear forces).

These interactions determine the movement of the matter on different levels: the weak interactions and the nuclear forces are the movers of the subatomic phenomena, in our surrounding mezoworld those are the electric forces to predominate, while the motion of the large mass celestial bodies is determined by the gravitational forces. On the level of atoms, molecules and bodies built up of these the electric interactions prevail. The four kind of interaction do not exclude one another their effect can get along together, simultaneously. In the stars, for example, the gravity can condense the matter till nuclear forces in the end start to be operative [12]. The manifestation of the individual interactive types may be very diversified depending on the material systems. For example, interactions between ions, dipole moments, various types of chemical bonds, the very weak dispersion forces between molecules and atoms not possessing of dipoles etc. can be traced back to the electric character. The peculiar manifestation of the interaction of moving electric charge is the magnetic space.

From the biological point of view the types of interactions are no more so clearly confinable. First of all, we can consider the metabolism as a fundamental interaction which realizes the unity of the living organism with its environment. It is also given the interaction of the individuals within the species, the interaction of the species between each other and we can also speak about the interaction of the biosphere and the lifeless environment. There are interactions on other levels as well, like those between the matter and the consciousness, the human life and spiritual manifestations, etc.

The major characteristics of the fundamental interactions are as follows: the time, the intensity, the range and the symmetry of interaction [13].

Generally spoken, with the characterization of the single interactions it is very important what kind of so-called symmetry they show, what symmetries hold true of them, i.e. what laws of conservation will predominate during the given interaction. In other words, one type of interaction exhibits symmetry against a certain character while nothing against the other. So the strong interaction shows symmetry against the rarity whilst the weak one not. Similarly, mating shows symmetry against the entity of the life but the death of the individual due to an infectious disease not.

Symmetries deserve particular attention. Some of them are valid for more types of interactions, others for less or eventually characteristic for only one. The laws of conservation valid for more interactions are as follows: that of energy, electric charge, the entity of life, the barion-charge, the impulse momentum, the lepton-charge, the rarity etc. The law of the information-conservation is in a special position which is known just as a presentiment but failed to be bound in the frame of quantitative correlations with the entities of energy, impulse, mass, life consciousness.

Effort has been made with the internetics to investigate not only the single types of the interactions on a least wide scale, but also the dynamics of the effect of the different interactions on one another [14]. We try to apply this attitude consistently in questions relating to the biophysics of the life. We are trying to explore the life-bound phenomena as a function of the mutual effect of the biological and the physical-chemical interactions.

The life under study is disappearing as we proceed from the living whole towards the lifeless constituents. This means that the life does not equal to the sum of its constituents. The more we dissect these living units the farther we get from the biology and finally we reach the superb, eternal and universal physical laws of the lifeless matter.

The living matter is such highly organized material system disponing a complex structure which is able to sustain this structure only by continuous workload – through the metabolism – performs work against the increment of the entropy. It is the right way if the qualitative difference between the single internetic levels will be reduced to the organization of the constituents. The whole cannot be explained on the basis of the parts, knowledge of the parts only procures the interpretation.

As it is evident from the preceedings, the phase space of the systems capable for chaotic movement rather complicated: at the same time, it contains the periodic movements found quite regu lar and those randomly confused. The situation starts to be very interesting when we enlarge a small detail. The enlar¬gement occurs with computer.

If we enlarge a small compart¬ment to its original seize we learn to get a spatial configuration of the same kind as the whole, i.e. you will find on it the discrete intersections of the periodic movements, of which a newer chain composed of finer links, moreover a diffuse set of points corresponding to the chaotic movement. If we now further enlarge a subcompartment of this enlarged compartment we get again the same kind of picture and so on!

In order to get a comprehensive image of the life, we have to harmonize the singular observations in the future, too, and syn-¬thesize the fragments even if we know that these fragments themselves are also delicately composite structures. Life is the attribute of the whole. But the indivisible whole is complicated beyond belief and brings the researcher into a difficult situation and, in the same time, it bids fair prospects to explore all beauties and mysteries of life for those who undertake it.

The Part and the Whole

The life under study is disappearing as we proceed from the living whole towards the lifeless constituents. This means that the life does not equal to the sum of its constituents. The more we dissect these living units the farther we get from the biology and finally we reach the superb, eternal and universal physical laws of the lifeless matter. The living matter is such highly organized material system disponing a complex structure which is able to sustain this structure only by continuous workload – through the metabolism – performs work against the increment of the entropy. It is the right way if the qualitative difference between the single internetic levels will be reduced to the organization of the constituents [15]. The whole cannot be explained on the basis of the parts, knowledge of the parts only procures the interpretation.

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