

## **The Biophysics is a Borderlan Science**

**Janos Vincze, Gabriella Vincze-Tiszay**

Health Human International Environment Foundation, Budapest, Hungary

e-mail: [ndp@t-online.hu](mailto:ndp@t-online.hu)

**Abstract:** From the philosophical point of view, the real world is of stratified construction. It contains five main strata: the inorganic, the organic, the social, the intellectual and the spiritual one. The specific character of the respective strata is constituted by their governing principles, categories which are fundamental predicates related to the existing entity as such, determinants (definitenesses) but not simple intellectual concepts or statements. Biophysics, by virtue of its character, creates connections between the inorganic, organic and spiritual stratum searching for their regularities. The predicamental (categorical) laws may be of horizontal type, connecting fields within the same stratum, and of vertical type when they create connections between different strata. The biophysics is moving in vertical dimensions which, however is not characteristic for every borderline science. Biophysics is a border science which deals with physical processes taking place in the living organisms and systems as well as with tools and methods used of their study.

**Key words:** biophysics, borderland science, categorical laws, psychology, three-dimensional model

### **Introduction**

It is the anthropocentric and geocentric way which has been, is and shall be characterizing the human activity, the general human way of thinking, the aim of life and the human spiritual life in every time and under every circumstances. If in the near future it will occur that crowds of human beings can emigrate in the space, then a superior human variant may come into existence. The four-milliard' global life and the spiritual activity of man has taken place in the continuous gravitational field of the Earth so being developed into its today's form and in this will occur a qualitative leap, because the alternating gravitational field will react upon and transform the processional schemes of the triplet inner-mechanisms of nature-living-soul and will also change the equilibration's and also the extreme values of its limits.

The science, this some three thousand year old form of human activity took significant growth in the last 300 years and has confronted with all those difficulties which are quasi inevitable concomitants of all new formation. Nowadays, when the objective conditions of the scientific development are mostly given, there are rather subjective factors to protract progress, among them of distinguished high priority: the hand-steering type activity of the leading personalities, the unscientific character of the decisions, the bureaucratic structure of the institutional systems of municipal services the fetishism of money, the looting nature of man the scientific search subordinated to economy, social corruption, human behavioral forms based on lies, the restraint from the unknown, avoidance of the shock-like impact of novelty.

## **A symbiosis of biophysics, physics, biology and psychology**

Life is not the result of the properties of special atoms, but is inherent in the high degree of organization of atoms that otherwise occur in nature according to the general laws of nature. At a certain level of organization in living systems [1], a qualitatively superior organization is created, which is reflected in spiritual life.

Biology begins with the observation and classification of living things, but the study of life phenomena already requires explanation and generalization. The progress was brought by the application of chemistry, biochemistry.

The contact areas between physics, psychology and biology, the way they are connected, are worth looking at from all three sides. Issues related to physics arise at all levels of biology: at the atomic and molecular level as well as at the level of cells, tissues, organs, and we can even go further to the level of individuals, populations, all the way to the biosphere. Today, the main development is to explore the relationship between structure and function as deeply as possible. However, the focus is less on the macro, nor on the micro, but on the atomic or molecular level. [2]

This endeavor is enforced when we use a variety of modern physical structure analysis methods, or quantum chemical, statistical physical methods, to explore intra- and intermolecular interactions that underlie the fundamentals of life processes, and also when we examine the cybernetic aspects of different life processes, or when we study life processes in terms of chemical substances, energy and charge transport.

We can observe that new discoveries in physics almost always drastically change our image of biological processes. Quantum mechanics has been a tremendous development in understanding the forces that hold molecules together and create intermolecular interactions. [3] The study of living world phenomena also contributed to the development of irreversible thermodynamics. There are plenty of examples of temporal and spatial oscillations in biology. The application of the latest results in statistical physics and irreversible thermodynamics represents a significant advancement in understanding the formation of biological structures as well as the origin of life. [4]

If we ask the question of what is needed from physics in biology in general and not in relation to a specific problem, we can say, without exaggeration, that almost everything that does not fall into the world of extremely large sizes and durations. Sometimes there are unexpected application possibilities, and it is these that can bring new results in principle. So a lot may be needed, and it may be the case that certain areas are given preference where appropriate.

Physics has developed a great number of measuring and testing procedures and a lot of tools over time to study the different properties of different materials. New methods and new instruments are also used to test biological materials over a short or long period of time. Again, methods and tools for exploring the material structure can be mentioned as a relevant example.

In addition to the possibilities discussed above, we must definitely address the more general significance of physics than the above. [5]

This is because the research methods of physics have evolved over time into a scientific approach. Exact observation, precise conceptualization, the search and exploration of quantitative relations, the efforts made for a quantitative interpretation of phenomena, the development of comprehensive and mathematically formulated theories, the constant interaction of theoretical and experimental research generally serve as models in all areas of scientific research, also in relation to biology.

Substantial differences in the individual behavior of the biological substrate, however, can only be understood or given a proper, more realistic interpretation if the psychological side of the biological system is taken into account. [6]

This is given special emphasis in the case of pathological activities, because the healing of a human system by physical means alone can be completely ineffective without considering the psychological ones.

### **Medicine ~ applied human biophysics**

Practicing medicine did not follow the results of basic biological and medical research with a great delay. This is shown by the recent development in medical imaging techniques; first, the time required for imaging was reduced by a fraction of a second, and then imaging following new principles were introduced (NMR, positron and scintillation camera, thermographic, computer tomography, scanning tunneling microscopy/STM/, PET, scanning atomic force microscopy/AFM).

Nowadays, an intensive care unit is unthinkable without data acquisition and process control structures (pacemakers, defibrillators, etc.) built of microelectronic elements. Through holography, the spatial and temporal course of bioelectric activity has also become traceable in three dimensions. This is already one of the applications of laser technology. But laser spectroscopy and laser-based photo-acoustic spectroscopy have also opened a new era in analytics. [7]

The use of high-energy lasers in surgery and ophthalmology is now well known. The results of cryobiology have been used for the long-term storage of cells and tissues. And hyperthermia is likely to play a role in the treatment of tumors. In the near future, the modernization of myographic and encephalographic examinations, the diagnostic application of electron microscopic X-ray microanalysis, and the introduction of biophysical examination and separation of cells into diagnostics and therapy are expected. Nowadays, decades of experience in computerized data storage, operation, mathematical statistical control and evaluation of medical and care departments is available. Computer science also allows the creation of non-statistical mathematical models of complex biological processes (drug kinetics, compartment models of the human body, brain and nervous system models). An example of this is the “artificial pancreas,” a device that models the body’s mechanism for breaking down sugar, constantly measures blood sugar levels, and determines the insulin dosing program that best mimics the function of a healthy pancreas. [8]

So biophysics examines the role of physical phenomena and laws in the structure of living matter, in life processes, so that we can then incorporate this knowledge into the general scientific worldview. In the school of thought and methods of biophysics we encounter the synthesis of physics, psychology and biology and apply the methods of examination of mathematics in its results. Promising endeavors are those that apply the results and methods of modern physics to the properties of the molecules that make up the body and to the simplest biological structures, for the more comprehensive exploration of elementary processes. [9]

### **Modeling**

Natural phenomena are in general very complicated. We have to select, therefore, the most characteristic parameters of the processes and create such constructions in which the processes can be realized with good approximation. A biological model is called that partial set to be studied which has been selected from the set of our available knowledge, assumptions as well as from the results of the already completed biological experiments and investigations. Hence the starting point of every modelling is some sort of an observable phenomenon. Modelling in simplest formulation can be conceived as a sharp polarized inquiry of the respective phenomenon. [10]

A fortunate model describes the given momentary acquirements but beyond this it enables assumptions which can be then translated into the language of the experiment and on this basis you can arrange certain new experimental conditions and situations. An adequately selected model will promote not only raising the question but also the scientific investigation of the phenomena. Natural science cannot be devoid of the model but it should meet the actual reality. Model cannot be constructed of anything. [11] There exist systems where the simplest model is the system itself.

Modelling in this case should just complicate the situation. In this sense there are explicitly good models but it's well known that there are also wrong things which, by modification, may work well. Model is evidently a model and not the reality but the abstracted copy of it from which we try to conclude to the reality and in the case of any mismatch we have to change the model.

In studying biological models we should like to identify regularities between numerous internal and external factors. According to our professional experiences, we choose those factors (constituents) supposed to play the most important role in the given biological model and these shall become the so-called active factors. [12] Those factors, on the other hand, bearing – in our recent knowledge – a negligible role in the given study are the so-called passive factors. The proper thing to do on behalf of the biologist would be to ask for the help of the physicist when collecting concrete biological facts and discussing results as one goes on. The physicist advises many a time to do this and that.

Every science has central questions such key issue in biophysics 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. [13]

The biologist has to abstract parts of the biological process substantial from the point of view of the model and has to select those essential points the physicist willingly accepts and in which he will be ready to collaborate. Hereupon as a rule, the physicist used to suggest an already existing model of the wide arsenal of the physics applied for the description of natural phenomena. If there is a physical model disposable for the biological phenomenon then it will bring up a lot of possibilities offered by the physics to the biology which, of course, must be subjected to biological-judgement. From many of them turns out that it's worth dealing with and being subjected to biological experimentation. [14] If our supposition has been justified by the biological experiment then we have got new knowledge in the long run. In this case model has given even more than it was originally for seen. In this respect, it's without doubt that the biological modelling is a useful way of collaboration between the biologist and physicist.

Biophysical model can help to see certain phases more clearly and sharply giving way for experimentation. [15] If you cannot get the features expected by the researcher then it is just the model to be wrong. But by all means, the biophysical model is always suitable to correct faults and direct further investigations in the proper way.

Another aspect which equally stresses the usefulness of the model on trial: once we keep a solution in hand we get a great number of testing chance through it as well. We can foretell on the basis of the model in what direction a given biological process shall deviate by changing single parameters. This contributes to increase the professional knowledge by which passive factors become active ones but it may turn out that some active factors were in fact passive ones. [16] Here, the biologist must be careful whether he should accept the model or wants to make modifications.

We should steadily see also the strict limitations of the modelling. Part of these limits is intensive and is best perceptible with the comparison that if we have a closer, focused look at an object it will necessarily get blurred or even disappear all beyond the scope of our observation. The other part of the limitations is extensive, the majority of the today's models cannot take into consideration more but some distincted features. [17] The mesh of the extensive and intensive limits, the complexity, underlines even more the necessity of modelling but it assures the conditions of the controllable advancement in a complicated spiritual (intellectual, mental) medium.

Forming a biophysical model is not the task of the biologist or physicist alone, a good model can successfully constructed only by common, collective-work. This is typically the task of the biophysicist and a problem which falls within the competence of this discipline. Model is always an approximation, the user of the model has to take into consideration that he can approach only the absolute truth just through the endless series of relative truths. For this reason, he performs certain neglects in advance, he disregards certain things. [18] The model is nothing but an abstracted

phenomenon, a momentarily stopped biological system. As soon as it has got a model it ceased to be alive but this should not exclude a model be built and the results of the biophysics be applied.

The obvious key issue is how single models cohere in what extent and in what way they can be related? If we rightly imagine 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. 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.

The biophysical approximation of the life processes leads always to the application of some kind of physical model. This model usually carries just some features of the process but complies the requirement of the accuracy. Accuracy is nothing else but to search for axiom for a complicated life process and it's usually a great deal of work. [19] Exactly from these difficulties germinates biophysics. The development of the biophysical science can be appraised on that we succeed in the investigation of ever complicated processes. Accordingly, in the research one must declare the axiom of the deductive theories achieved by the study of the processes. You should clearly start with very simple examples. Again, the more complicated life processes we tackle, the higher we raise the scientific level of the biophysics.

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, paleontology 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.”

Taking into account 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 more true 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. 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 Three-Dimensional Model of Sciences**

It is clear that the classification of sciences, based on the forms of motion, contains a number of contradictions. The following three-dimensional model [20] goes one step further by taking into account both the forms of motion and the overlapping levels of existing systems. According to this idea, the real world has a layered structure. It contains five main layers: the inorganic (inorganic systems), the organic, the social, the intellectual and the spiritual. The specific nature of each layer

is formed by the principles and categories that prevail in it, which are basic statements and definitions of the existing as existing, and not merely intellectual concepts or statements.

The first layer includes disciplines dealing with knowledge that put inanimate systems at the center of their research: mathematics, physics, chemistry, geology, geography, astronomy, etc.

The second layer includes the disciplines dealing with living systems: biology, medicine, agronomy, sports, etc.

The third layer includes the social sciences: history, philosophy, economics, technical sciences, sociology, law, etc.

The fourth layer includes the disciplines and knowledge of intellectual activities: linguistics, literature, poetry, language skills, logic, etc.

The fifth layer is the repository of our knowledge of spiritual phenomena: psychology, ethics, religion, arts, etc.

The different areas are not closed and related problems are examined in a number of classical fields. This is what interdisciplinary fields were developed for, which can make a connection horizontally, at the level of the same layer, such as: physical chemistry (first layer), phytopathology (second layer); or vertically between different layers such as: biomathematics and biochemistry (between the first and second layers), mathematics linguistics (between the first and fourth layers), social psychology (between the third and fifth layers), etc.

But interdisciplinary fields can also emerge between several layers, such as biophysics, which connects the first, second, and fifth layers. Biophysics, by virtue of its character, creates connections between the inorganic, organic and spiritual stratum searching for their regularities. Today, they are several hundreds of interdisciplinary fields.

Categorical laws can be of the horizontal type when they connect areas within the same layer, and vertical when they create connections between different layers. The interdependence and independence of the individual layers is determined by the so-called "Dependence laws".

The first law of dependence is the law of "force": categorical dependence exists only from the lower to the higher layer, there is no dependence relationship the other way. The lower layers are thus determinatively stronger, but the strength and height of the layers are inversely related to each other. This means that it may make sense to explore physical laws and their limits of applicability in biological systems, but at the same time to study the applicability of biological laws in physical systems may be unreasonable.

The second law of dependence is "width", which states that the lower layers are more numerous than the higher layers, and the higher layers may include, but are not limited to, certain systems of the lower layers.

The third law is the law of "structuring", which states that the internal structure of systems in the higher layers is more complex than the internal structure of the lower layers.

The three-dimensional model of sciences points to the organic unity of the world, and which is more perfect in its uniformity and consistency than anything previously drawn. This model documents that the movement system of the material and spiritual worlds forms a unity, and that, without the knowledge of the realities, human literacy becomes unfounded, and vice versa.

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