ISSN: 2577 - 8005

Review Literature

Medical & Clinical Research

The biophysical modelling of the human organism by the biophysical point of view

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Submitted: 30 May 2023; **Accepted**: 22 July 2023; **Published**: 02 Aug 2023

Citation: *Vincze J, Vincze-Tiszay G (2023) The biophysical modelling of the human organism by the biophysical point of view. Medical & Clinical Research, 8(8), 01-03.*

Abstract

Biophysics is searching for, dealing of and teaching the forms of the connections between the inanimate nature, the living world and the spiritual life, the applicability limits of their own laws in the other medium, their common mutual interactions. Biophysics undertakes, by means of mathematics, desc¬ription of the so-called homeostasis established by the dynamic equilibrium of the common normal state of the nature, the living world and that of the spirit. According to system theory, the human is a system, the five subsystems of which (digestive, respiratory, circulatory, exc¬retory, and reproductive) formed during phylogenetic develop¬ment short are addressed in this article. In living organisms, structure and function can be con¬sidered as a symbiosis: structure defines function, and function influences, modifies and develops the struc¬ture, which again enables a higher level function and activity. Many long-lasting structural perturbations result in func¬tional perturbations and similarly, long-lasting functional perturbations result in structural perturbations. This perturbation symbiosis is represented by the large group of psychological perturbations.

Keywords: Apparatuses in the Human Organism, Homeostasis, Transport Phenomenon

Introduction

The 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 [1]. 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 [2]. The current trend in biophysics are thus the efforts made for comprehensive results, which seek to explore molecular and atomic processes in biological objects, as well as spiritual phenomena through the structure of the nervous system [13].

The connection between the three fundamental sciences, physics, psychology and biology, is usually illustrated by intersecting circles arranged in the simplest way in a triangular shape. The circles symbolize the sciences, their overlapping areas symbolize the interdisciplinary fields. The common area of all three circles represents a field of science that is related to all three basic sciences and uses the tools of mathematics as an objective method [4]. This includes all that we have referred to above, the character of which is general, comprehensive and at the same time attests to the unity of nature [5].

Finally, no basic science can be considered a closed science, but an interdisciplinary field such as biophysics cannot be considered as one in particular. An essential feature in biophysics is the tendency to bring together hitherto highly differentiated disciplines and merge this part of natural science into a single, unified discipline.

The Biopsychological System

The environment K of the system R is what is outside the system. Everything that does not belong to the given system is called environment. This is also not easy to define [6]. This is why the scientist must have considerations of the system environment that are richer and more complex than the mere study of boundaries P (edge) [7]. Very often, the environment is not only beyond the control of the system, but also something that partly determines how the system works.

$$P = R \cap K$$

The system and environment are not disjointed. What they have in common is the edge of the system, the finite-sized closed surface that separates the system from the environment. Through the edge, there is an interaction between the system and the environment.

The edge is part of both the system and its environment. Its position determines the static location of the system, its geometric location within the environment. At the same time, however, as a medium that can be characterized by a factor of conductivity, it determines

the dynamic relationship between the system and the environment, as well as the interactions between them.

In order for a system to become the subject of scientific study, it must be precisely separated from its environment in space and time. This is only possible if, on the one hand, we are able to highlight the system in accordance with the established interconnection rules, and if, on the other hand, we are able to delineate the relationships and interactions between the system and its environment. In this case, the subsystems appear inside the system on each other or on the system, or the coercive effect of the system on one or the other, which is also influenced by the edge conditions, through their so-called coefficients of conductivity (V_{jk}).

The numerical value of the coefficient of conductivity gives the current of the extensive quantity (**w**) for a unit time difference of an intensive quantity (**z**). If the edge is divided into Sk units of homogeneous surface:

$$P = \sum S_k$$

Then the total flow of the extensive quantity wj over the surface of the whole edge S:

$$w_j = \int_S S_k \sum_{r=1}^{n} v_j \; grad \; z_r$$

This seemingly complicated formula becomes easier to understand when we think of the cells that make up living organisms [8]. Conductivity indicates that the cell membrane is permeable to a particular substance. The permeability of a surface also varies with time per unit. If impermeable to a given material, then the row vector of the conductivity matrix consists of zeros. If we apply it to the vectors of the conductivity matrix column, it means the effect a generalized force (grad F) has on the corresponding flux φ [9].

If we provide a definition of transport phenomena in living organisms and its mathematical description, it would result in the elaboration of the interaction between the system and its environment for the relevant specific case. By transport phenomena we mean the change in "generalized forces" in time and space when they create fluxes to which the conservation laws apply [10].

If W-the amount of the transported parameter, for which the conservation law is valid; K-a constant dependent on the type of transportation and the nature of the transported parameter; grad a-the generalized force, then the amount of the parameter (flow) transported through the surface dS in the dt time frame will be given by the relation:

$$W = K \int_{t_1}^{t_2} \iiint_{S(x,y,z)} grad \; a \, dS \, dt$$

"Mens sana in corporis sano"-that is *"a healthy mind in a healthy body"*-refers to the inseparable unity of the biological and the psychic [11]. Neither can exist without the other. No matter how elusive psychic events are, the organic substrate for this is provided by our individual biological structure. The unit is thus made up of two parts, operating separately, but mutually determining each other's functionality. An equilibrium system develops in which when a function is disrupted it burdens the functioning of the organs associated with it which creates a dysfunction in the organ itself as well as in the body and they react to each other. For example, in the case of anorexia or bulimia, both of which have psychological causes and are somatic, the nerve center responsible for disrupted hunger and satiety generates organic damage.

In this, from a biophysical point of view, there are psychosomatic and somatopsychic, i.e. psychiatric disorders caused by organic dysfunction (the latter, for example, kidney diseases, brain tumors, gastric ulcers, etc. are accompanied by psychological changes) are formed. Emotional stress results in anxiety with vegetative accompanying phenomena (sweating, temperature changes, flushing-paleness, nausea, diarrhea, urinary urgency, etc.). If these vegetative phenomena are repeated, they can also result in organ damage. This is called psychosomatic specificity.

Homeostasis

The dynamic equilibrium state can be thought of mathematically as a sinusoidal oscillation at a certain time (**t**), characterized by the amplitude (**A**), angular velocity (**ω**), period (**T**), frequency (**ν**) and phase (**φ**) of intensity:

$$x = A \cdot \sin(\omega t + \phi)$$

If a biopsychological system responds specifically to an external stimulus, it means that the value of some of its parameters changes and then returns to its original state of homeostasis when the response is complete. Parameters characterized by static equilibrium and is involved in the response return their values over time to their original value such that its envelope is an exponential (ascending or descending) curve [12]. The parameter that is characterized by a state of dynamic equilibrium and is involved in the response returns to its original value with attenuated harmonic oscillation after its completion. The duration of the return is different for each parameter, and the normal state of homeostasis is determined by the parameter with the slowest finish [13].

Our Human Perspective

There are more and more recognized conflicts between humankind and their environment. The accelerated pace requires humans to act and live with an accuracy of the minute and even second, but there is no such precision regulation in the biorhythms of living organisms [14]. The law of natural selection has ceased to have an effect in human society, and social laws have created an artificial

selection milieu in which the probability of survival is virtually the same for both the weak and the strong. In this way, the most decisive biological driving force of the development of the human race has been pushed back. People's attitudes change slowly, the adoption of new techniques, learning to use them due to back-and-forth opinions and expressions of will, is a significantly slow process [15]. People are afraid of the new, the bigger, the foreign, they are blocking themselves out, they feel vulnerable and they consider it potentially dangerous. The goal is clear and perhaps more easily achievable: millions, hundreds of millions must move from the known state of Homo laboras (working human) to the higher state of Homo studiosus (learning human) without losing their basic Homo ludens (playful human) nature along the way, without which we could hardly endure the vicissitudes of life.

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