

The Biophysical Modelling of the Different Regulations in the Human Organism

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Abstract: *In higher-level living organisms the following forms of regulation are known: nervous, hormonal, humoral and immune regulation. In the case of humans, psychic regulation also appears due to the existence of psychic activity. Human congenital types of regulation are, in part, the nervous, the hormonal and the immune regulation. The fundamental functioning mechanism of the nervous system is the reflex, which represents the response reaction of the nervous centres to the stimulation of a receptor area. The reflex arc is made of five components: the receptor, the afferent pathway, the nervous centres, the efferent pathway and the effector. The reflexes are somatic, vegetative, unconditional and conditional. The endocrine glands are organs the cells of which produce hormones with different effects. These glands release their hormones regulating their vital function directly into the intercellular space and thus into the bloodstream. Hormones can thus produce their effects on organs distant from the gland. The immune function integrated in the complex system which insures the maintaining of homeostasis, the body's integrity and the body's adaptability. During a person's ontogenetic evolution, its psychic regulation changes, new types of nerve connections are formed due to conditional reflexes and immune regulation can also be acquired regulation. Living organisms carry out humoral regulation in accordance with the laws adopted from inanimate systems. I are written a comparative table of parameters of the types of regulation.*

1. INTRODUCTION

The human organism is composed of a number of subsystems: cells, tissues, organs, organ systems, apparatuses and, above all, the living human consisting of one system. If our bodies are subject to external or internal stimuli, these affect one of the subsystems. The task of this subsystem is to initiate a response in the context of classical regulatory processes. The human body as a whole often overrides this response based on its inherited experiences and the ones gained during its ontogenesis. This means that the organism as a whole has a state of consciousness by which it chooses the nature of the response. In such cases our consciousness might not give any response as a result of the stimulus! During the show, the magician does not respond to what the audience shouts. Patients taking pills and feeling slightly nauseated would not care as they know it is only a secondary effect of the medication.

Living systems are separated from their surroundings by an outer cover, in the case of humans, skin. When discussing skin, it becomes clear that it is

not a passive boundary between the body and its surroundings, but it actively protects the organism against the harmful effects coming from the environment, and thus contributes to the self-sustenance of the body as a living organism.

The living system is integral in its nature as opposed to its environment, in order to maintain its living status; this is also part of biological regulation. Biological regulation is thus a general form of regulation that we can encounter in living systems. The control center of biological regulation is likely to be found in the genetic material, the DNA genes because this is closely related to the existence of the living organism as a system. [1]

2. NERVOUS REGULATION

It is well known that the neuron changes its resting potential and the stimulus generates an action potential. At the level of the synapses, the stimulus is transmitted to the next neuron by chemical mediators. The stimuli arrive on ascending pathways at the centers of the nervous system, and from there the corresponding responses, in the same way, reach the effector organs (muscles, glands etc.) via the descending pathways. This is an inherited property of ours, which we cannot influence, because if the strength of the stimulus exceeds the threshold of stimulation, this phenomenon is created. However, in the case of conditional reflexes, the path of the stimulus is the same. Nervous regulation creates the possibility that the characteristic parameters of our organisms oscillate around an average value, i.e., result in a state of dynamic equilibrium. [2] Our homeostasis is provided by their combined functioning. Nervous regulation is extreme and effective, it provides very precise responses and the existence of the human being as a living organism is impossible without it. [3]

3. HORMONAL REGULATION

The endocrine glands secrete the hormones. From the biophysical point of view, a hormone is the support of an information with the purpose to modulate or orient the functionality of the target cells, according to the current or perspective needs of the organism. The hormonal information is selectively „recognized” then transduced in signals capable to modify the cell functioning „program”, which „perceived” the message through specific receptors. The hormonal concentration in the internal environment is extremely low in report with the amplitude of the metabolism it commands.

The receptor of the target cell has a high specificity, based on which it recognises the hormone and a special affinity, due to which it bonds the hormone. In reality, the specificity is relative, because its activity can be realized by antagonists as well. Both the affinity and the number of receptors vary according to several factors. One of them is even the concentration of the circulating hormone.

We argue that the different types of regulations also have a control center. The center of hormonal regulation, according to all researchers, is the system of hypophysis and hypothalamus, this part of our body produces the so-called trophormones that act and control the other endocrine glands.

4. NERVOUS-HORMONAL REGULATION

Since the nervous system is an analogical, non linear and probabilistic system, it works in temporal-spatial code and it functions as a stochastic machine. The efficient functioning with a minimum of errors is ensured by its redundant structure, the excess of neurons of the neuronal connections, its super-network character. [4] In comparison with the hormonal and humoral integrations, the nervous integrations obtains adaptation response of the entire body faster, more differentiated and faster to modify, corresponding to the very different rapid and continuous variations of the external and internal environment.

The active chemical agents are produced, stored or released from any tissue or organ except for the endocrine glands. The terms of tissular [5] or local hormones are used currently for naming these substances, which differ from the hormones of the endocrine glands with three essential characteristics: a) they are not produced by specialized organs whose function only consists in the production of these substances; b) they are not flown in the blood flow in order to exert their action on some remote organs; c) its not mandatory that they are produced in the living organism, many substances can also be inorganic.

Almost all the chemical agents reunited under this name are also being given a biophysical role – as tools for obtaining adjustment and the neuro-hormonal-humoral integration of the bodily functions as well as a physiopathological role – as biochemical mediators of certain pathological phenomena. [6] Each cell contributed to maintaining relatively constant the composition of the internal environment as well as to its modification, being influenced on its turn, by the products of all the cells.

5. HUMORAL REGULATION

In our opinion, this is the oldest type of regulation of living organisms because it has been inherited from inanimate systems. Humoral regulation is created when two or more components are present at the same time in a liquid or gaseous state multi-component

system. In this case, the forces applied to physical concentrations, emerging between the different components (see chapter I section 4), as well as the underlying mechanisms are in control; in the living systems, however, the semi-permeable membranes have an active role, as well as the receptors specific of ligands. [7] The center of hormonal regulation, according to all researchers, is the system of hypophysis and hypothalamus, this part of our body produces the so-called trophormones that act and control the other endocrine glands.

6. PSYCHIC REGULATION

During the phylogenetic development of living organism, in a certain level appears the nerve system. Furthermore, in a continuous development the nerve system generates a new qualitative state with the function of spiritual activities. The psychological activities have their own relatively independent rules. Every person remembers about his or her past happenings, planning its future, thinking about relations, feelings encourage or discourage, every person striving, wishing, deciding, and wanting. The organization of the psychic process within the realm of reflex-process has its three-folded division, which during its ontogenetic development became more differentiated. During the ontogenetic development, the sense for cognition is supported by the abstraction capability. The human sense of cognition varies by the nature of the individual, this is the reason why one can recognize a typically personal mode of thinking, underlined by the individual phrases, construction of sentences and forms of expressions. The relationship between the spiritual manifestation and the progression in the nerve system could be defined by the following formula: in all time when we live through spiritual happenings, reactions go through the nerve system. The nature of the psychic content, quality and source will be determined by the individual's interaction with its environment. We could talk only about a specific nature of an individual if we examine the totality of spiritual events, the person's cognitive, attitude, and assimilative capability during his lifetime. In fact the individuality of a person could be only recognized by an analysis in a horizontally employed chronological lifetime.

Psychic regulation only characterizes the human organism [8]. This regulation varies greatly during ontogenetic evolution, because personality becomes fully developed only by adulthood. The perturbation of the human organism may be hereditary or acquired. Depending on the level on which psychic regulation becomes successful, the human body is forced to use this form of regulation for a longer or shorter period of time. The shorter or longer path depends on the absence or creation of organic changes as the result of psychosomatic perturbation. It should be emphasized that the body's return to the original homeostasis always means that due to the existence of

biological hysteresis, the body preserves the type of perturbation in the repository of psychic memory. If the same perturbation affects the organism again, the intensity of its effect increases, thus the psychosomatic change is most likely followed by organic change as well.

From the cybernetic point of view [9], there is a series of resemblances and differences between the nervous, hormonal and humoral regulation. In order to take a brief comparative look to the most resembling aspects they are written in a comparative table.

Parameters of the types of regulations

Parameters	Types	Humoral reg.	Hormonal reg.	Nervous reg.	Psychological reg.
Appearance in phylogenesis		Unicellular	Metazoa	Hydrozoa	Human
Information Channel		None	Indirectly through blood	Neuron	Superordinal groups of neuron
Adjustment centre		None	Yes	Yes	Mnemonic repository
Latency time		None	10^{-10} s	10^{-7} s	10^{-10} s
Action period		10^{-10} s	10^{-10} s	10^{-10} s	10^{-10} s
Circuit type		Open	Closed	Closed	Closed
Inertia		Average	High	Small	Little
Sensitivity		Variable	Low	High	Big
Answer accuracy		Diffuse	Diffuse	Exact	unequal
Number of controlled states		Low	Median	High	Individual
Number of parameters which are modified under the action of the exciter		One	A few	High	Variable
Subordination level		Inferior	Mean	Superior	Highest degree
Substances or states which transmit the information		Passive substances	Hormones	Electric potential chemical mediators	First and second signaling system
Reception system		Specific receptor effector cells	Hormonal receptors	Intero-, extero-proprioceptors Free nervous terminations	Cognitive organization
Adjustment form		Direct	Indirect	Indirect	Indirect
Conscious adjustment		Impossible	Impossible	Possible	Consciously
Time of exhausting the capacity of the repetitive answer		Short	Mean	Long	Variable

7. TYPES OF INVERSED CONNECTIONS

In all types of regulation is valid the feedback connection. The feed-back or negative inverse connection functions “constantly” and its main role is, to maintain certain functional parameters of the body to a relatively constant value. This is about a relative stability, since the adjustment involves oscillations around an abstract medium value with a tendency to minimize the deviation in respect of this mean value.

Let’s denote with $o(t)$ the exit output and the mean value of the characteristic parameter on the system is $o^*(t)$; after the adjustment, the values of the outputs obtained shall be denoted with

$$o(t_1), o(t_2), o(t_3), \dots, o(t_n) = o^*(t);$$

if $t_1 < t_2 < t_3 < \dots < t_n$.

We talk about a negative inverse value, if the following two conditions are satisfied:

$$|o^*(t) - o(t_1)| > |o^*(t) - o(t_2)| > |o^*(t) - o(t_3)| > \dots > |o^*(t) - o(t_n)|$$

$$\frac{d|o(t_i) - o^*(t)|}{dt} \leq 0.$$

In the living organisms, all the mechanisms for maintaining a constant composition and internal environment function on the basis of on negative feedback. The positive reverse connection is the

connection which introduces an amplification of the effect caused by the entry signals. Maintaining the denotations above, we speak about a reverse positive connection, if it fulfils the following two conditions:

$$|o^*(t) - o(t_1)| < |o^*(t) - o(t_2)| < |o^*(t) - o(t_3)| < \dots < |o^*(t) - o(t_n)|$$

$$\frac{d|o(t_i) - o^*(t)|}{dt} \geq 0.$$

8. CONCLUSIONS

Living organisms have special regulatory mechanisms to maintain the living condition. Such special regulatory mechanisms include biological, neurological, hormonal and immune regulation. According to our hypothesis, all of these have an independent control center. We argue that the different types of regulations also have a control center. psychic regulation, which occurs in the case of humans as the highest regulation, has a control center in these groupings of nerve cells, which is called mnemonic repository. In the case of humans, a special form of regulation appears, that is psychic regulation, the center of which is the mnemonic repository consisting of spatial superordinate neurons. [10]

Due to the emergence of psychological regulation, doctors should consider the priority of causes for diseases during diagnosis in order to decide which the primary cause is: the perturbation of the biological system or that of the psychic system, as this will help decide whether it is a somatopsychic or psychosomatic state.

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