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The Biophysical Modelling of the Features Specific to the Human Organism

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ABSTRACT

The metabolism is the fundamental criteria of limit between the structure of the living and non living organisms. For any internal or external excitation, the value of certain parameters changes and through adjustment, after a time interval, the value of the parameters returns to the initial state. The organism is a system and health is a characteristic state of this system. The health cannot be reduced only to the absence of the disease; to be healthy means to be in an optimal force, both physical and intellectual. Stress is a state of putting in alert, of mobilizing the forces of the organism in the occasion of an event which requires, in order to be kept under control, a big amount of energy in a very short time. The person who states that they would kill themselves must consult as soon as possible a clinician psychologist. The medical research of Selye found a connection between disease and stress. The disease is the result of the perturbation of the information exchange between the various functional systems between the organism as unit and its life environment, as well as the energetic support which gives human viability. The adaptation capacity and the homeostatic adjustment are ensured at this phase as well through neurohormonal, cellular and intracellular adjustment mechanisms. The model shows how complicated it is to assess if, after a **t** interval, a normal cell becomes a cancerous cell after "cancerous fluctuations".

Key words: Metabolism, Stress

INTRODUCTION

Which are the most important features that can distinguish non living systems from the living ones? Excitability, adaptation, sexuality, aging, phylo- and ontogenetic development; the fundamental criterion is metabolism.

By excitability we understand the property of all living cells to respond through excitation to the energy modification of a certain intensity and duration. The organisms must adapt the functions and the structures every moment and along their entire existence to the environment's change and renewal realities. This way their preservation as beings, as populations, as species is obtained. At the adaptation modifications which regard the human organisms as animal species, we must add the great contribution of the cultural adaptation which differentiates man from other animals and through which men ensures their complex protection means from the environment factors, of adaptation to unfavourable extremes. A special role in the cultural adaptation belongs to the adaptation behavioural mechanism, which is achieved through the brain and in accordance with the social factors, with the tendency of progress of the human society. The sexuality does not have only a reproductive biological function, but it has other as well: multiplicative, fortifying, selective, diversifying. In a wide biological perspective, death and aging itself are indispensable conditions of the evolution of life on Earth, made „room" for the repeated development of the competition between individuals and the repeated selection of the most adequate ones.

The most important characteristic of the living matter is represented by the substance exchange between the organism and the environment. The metabolism is the fundamental

criteria of limit between the structure of the living and non living organisms. If a living structure does not have any form of metabolism, then it loses viability.

HEALTH

To know how to cure your own health is a necessity both individual and collective. It is individual because each of us is responsible for their body: to take care of health means, first of all, to respect the needs of the organism through good life hygiene, avoiding everything that is toxic, listening to the alarm signals or the symptoms (fever, pain) that the body transmits (Vincze, 2018).

A healthy person (E) is characterized by the parameters (N**)** which are found in a dynamic equilibrium. For any internal or external excitation, the value of certain parameters changes and through adjustment, after a time interval the value of the parameters returns to the initial state. The organism is a system and health is a characteristic state of this system. Between the structural elements of the organism and the function, we will denote the relations with small Greek letters and between the structural elements to function with big Greek letters.

Hence, in a normal homeostatic state of the organism, the following diagram applies:

$$\begin{array}{ccccccc} N_j^* & \xrightarrow{\alpha} & N_j^1 & \cdots & N_j^m & \xrightarrow{\eta} & N_j^* \\ \downarrow\Psi & & \Phi\downarrow & \cdots & \Sigma\downarrow & & \Omega\downarrow \\ E_j^* & \xrightarrow{\gamma} & E_j^1 & \cdots & E_j^m & \xrightarrow{\nu} & E_j^* \end{array}$$

where: N_j^* represents the normal value of the j parameters, until N_j^m (m = 1,2, …) the intermediary values of the **j** parameter during the excitation. Obviously in our diagram for morphism and functions are valid the general rules known in the theory on categories. The presented one is a biophysical model for a healthy organism.

The health cannot be reduced only to the absence of the disease; to be healthy means to be in an optimal force, both physical and intellectual.

The health state of the upper living organism includes its capacity to maintain the constancy of the biophysical, biochemical and functional (homeostasis) parameters regardless of the modifications of the external environment, which according to the second thermodynamics principle seeks to reduce order, to dissipate energy and to destructure. Health is a „physical, mental and social optimal state of the human organism", the human being is seen as a bio-psycho-social entity.

STRESS

Stress represents a normal reaction of the organism which appears as a response to an aggression situation which requires an unusual and quick adaptation effort from the organism. Stress is a state of putting in alert, of mobilizing the forces of the organism in the occasion of an event which requires, in order to be kept under control, a big amount of energy in a very short time. This alert state or action preparation translated through physical and psychological manifestations (Vincze, 2007a).

In some cases, the stress state can extend. For example, in the situation in which no immediate solution for dismantling the stress factor is seen. In this situation the organism does not see around itself the necessary resources for overcoming the disturbing factor. As a

consequence, it cannot give up effort. Stress complicates with a state of excessive agitation which corresponds to anxiety.

Anxiety represents a real psychological alarm system. It initiates when a situation seems – rightfully or not – difficult to control or when the solution does not seem to appear. Such a situation puts at trial the equilibrium of that person and requires from the organism an extra mobilization effort. The person fights against the „stressing" event, struggles inside and intensifies the efforts they must sustain sometimes for a long period of time. Hence, anxiety is a disease from the psychological point of view (Vincze, 2008).

The organism sinks more or less rapidly in a state of advanced exhaustion, both physical and psychological. The psychological exhaustion must always be seen carefully because, in serious cases, some people cannot face the difficulties of life anymore and can commit suicide! The person who states that they would kill themselves must consult as soon as possible a clinician psychologist.

We have modelling the stress by category theory so:

$$\begin{array}{ccccccc} N_{ij}^{*} & \xrightarrow{\alpha} & N_{ij}^{1} & \cdots & N_{ij}^{m} & \xrightarrow{\eta} & N_{ij}^{**} \xrightarrow{\sigma} N_{ij}^{*} \\ \downarrow \Psi & & \Phi \downarrow & \cdots & \Sigma \downarrow & & \Omega^{*} \downarrow \quad \Theta \downarrow \\ E_{ij}^{*} & \xrightarrow{\gamma} & S_{ij}^{1} & \cdots & S_{ij}^{m} & \xrightarrow{\nu} & S_{ij}^{**} \xrightarrow{\tau} E_{ij}^{*} \end{array}$$

Between 1972 and 1975 J. Vincze issued the hypothesis that the women who breastfeed transmit the stress state to the baby. Further on – J. Vincze – formulated that the stress state in the case of pregnant women passes – during pregnancy to the foetus. An ample dispute appeared in these two problems, but later several researchers demonstrated the correctness of these hypothesis through various paraclinical methods.

The medical research of Selye (1936; 1946; 1955; 1956) found a connection between disease and stress. Simple and complex, acute and chronic diseases are formed after the lack of adaptation towards stressing situation, for example bacteria, electronic smog, toxic matters or direct or indirect action of noxae on the body. On its turn it results through inadequate responses performed by the organism, as a response to the ambiance stimuli: through different hypertonias, gastric and duodenal ulcer, general hypersensibility, bronchial asthma, blood circulation diseases or renal diseases.

DISEASE

The disease represents the expression of endangering the adjustment mechanisms of homeostasis, a deviation from the „normal" seen as a statistic mean which varies according to age, sex, endogenous biorhythms etc. Disease represents the disturbance of the homeostasis adjustment mechanisms; the disturbance of the nervous, endocrine, humoral and immune adjustment (Vincze, 2018).

Hence, the disease is the result of the perturbation of the information exchange between the various functional systems between the organism as unit and its life environment, as well as the energetic support which gives human viability. Thus, the disease is an organic or functional modification of the body's normal equilibrium, a pathological process which affects the organism in its entireness.

From the biological point of view, in the disease state the adaptation capacity is fundamental. This phenomenon must be understood both at the level of the functions of various organs and at the level of the cellular metabolism. In sick people the adaptation capacity which includes the ensemble of the adjustment mechanisms which lead to the

dynamic equilibrium of homeostasis functions slower and sometimes insufficiently (Schulkin, 2006). The dynamics of the homeostatic equilibrium implies in sick people a constant of the parameters of the internal environment: blood pH, partial pressure of O_2 and CO_2 in blood and cells, a certain ion concentration. The adaptation capacity and the homeostatic adjustment are ensured at this phase as well through neurohormonal, cellular and intracellular adjustment mechanisms. In sick people some particularities of the adjustment mechanisms which lead to inertia are highlighted, with the slow reestablishment of the homeostasis (Horowitz, 2002; Vincze, 2018).

Homeostasis is disturbed especially in the stress conditions. The adaptation mechanisms establish difficulty or insufficiently, the parameters are disturbed by these solicitations. Frequently, the disease state determines a progressive and even irreversible alteration of the internal environment.

We have modelling the disease by category theory, so:

$$\begin{array}{ccccccccc} N^{*}_{ij\cdots k} & \xrightarrow{\alpha} & N^{1}_{ij\cdots k} & \cdots & N^{m}_{ij\cdots k} & \xrightarrow{\eta} & N^{**}_{ij\cdots k} & \xrightarrow{\sigma} & N^{*}_{ij\cdots k} \\ \downarrow\Psi & & \Phi\downarrow & \cdots & \Sigma\downarrow & & \Omega\downarrow & & \Theta\downarrow \quad \Gamma\downarrow \\ E^{*}_{ij\cdots k} & \xrightarrow{\gamma} & B^{1}_{ij\cdots k} & \cdots & B^{m}_{ij\cdots k} & \xrightarrow{\nu} & B^{**}_{ij\cdots k} & \xrightarrow{\tau} & E^{*}_{ij\cdots k} \end{array}$$

The excessive technicality of the diagnosis made the sick people subject of stressing and sometimes useless paraclinical investigations. Current practice showed that the clinic exam is indispensable in the elaboration of the diagnostic. If the clinic exam cannot establish the diagnostic itself, it constitutes the starting point in the paraclinical investigations.

It is implied that the biophysical changes responsible for the transformation of a normal cell in a cancerous cell are of accidental nature and represent a “cancerous fluctuation” (Shields et al., 2017).

We consider the case of a uniform population of individuals and let p(t)dt be the probability that each of the cells of an individual suffer a cancerous fluctuation in a time interval t and t+dt.

In order to determine the probability that the individual gets cancer for the first time at the age t, we divide the time interval in small intervals Δt. We suppose that until the interval **k** and with P_i probability that a cancerous fluctuation does not appear in the first i–1 intervals and appear in the i interval.

We have

$$P_i = (1-p_1)\,(1-p_2)\,\ldots\,(1-p_{i-1})p_i$$

Because $p_k < 1$, it results that

$$\ln\prod_{k=1}^{i-1}(1-p_k)=\sum_{k=1}^{i-1}\ln(1-p_k)=-\sum_{k=1}^{i-1}p_k$$

and hence

$$P_i = p_i\cdot\exp(-\sum_{k=1}^{i-1}p_k)$$

Let P(t)dt be the probability of a cancerous fluctuation in an individual for the first time in the interval (t, t+dt), namely

$$P(t)dt=\left[1-\int_0^t P(\tau)d\tau\right]p(t)dt+o(dt)$$

So we can take:

$$P(t)=\left[1-\int_0^t P(\tau)d\tau\right]p(t)$$

Denote

$$Q(t) = 1 - \int_0^t P(\tau)d\tau$$

from where

$$-\ln Q(t) = \int_0^t p(\tau)d\tau$$

So

$$Q(t) = \exp\left[-\int_0^t p(\tau)d\tau\right]$$

get

$$P(t) = p(t)\cdot\exp\left[-\int_0^t p(\tau)d\tau\right]$$

and denote

$$\ln P(T) = \ln p(t) - \int_0^t p(\tau)d\tau$$

From this relation we obtain:

$$\frac{dp}{dt} - p^2 = \frac{p}{p_1}\cdot\frac{dP_1}{dt}$$

If we suppose that p(t) = p (const.), it results

$$P(t) = p\cdot e^{-p\cdot t}$$

Under a more general form, we can consider the case when a normal cell becomes cancerous after k casual fluctuations of it (Vincze, 2007b). Obviously, a fluctuation will leave marks which will increase the probability of the following fluctuation. If we suppose the simple case when the p probability of a fluctuation is constant and independent from any other fluctuation and if we divide the interval (0,t) in n equal intervals, then the probability belonging to a fluctuation in any interval is $\pi = p.\Delta t$. Also, the probability of apparition of the fluctuation only in k–1 intervals of n samples will be

$$p_n(k-1) = \frac{n!}{k!(n-k+1)!}\pi^{k-1}(1-\pi)^{n-k+1}$$

This model shows how complicated it is to assess if, after a **t** interval, a normal cell becomes a cancerous cell after "cancerous fluctuations".

There are no clear and fixed boundaries between health and sickness. The disease is a fundamental category of medicine. It appears after multifactor effect as an activity deficiency of the organism. The substrate can be an anomaly, a morphological lesion, a disturbance of the biophysical or biochemical process etc. a sick person is entirely sick, their entire personality participates to this state. The person enters the disease with a certain type of nervous system, temperament, character, intelligence, hereditary antecedents. The sick person is interested in their disease more then when they were healthy. Although we do not feel health, the symptoms of the disease are bothering.

In sickness, egocentrism, egoism and irritability increase, sometimes they degrade personality making it regress. Often, the creative capacity and objectivity decrease.

Very frequently, except for the medical exam, the sick people also need a psychological exam. The clinician psychologists study the personality of an individual in particular, help their patient at solving behaviour and/or emotional problems. After their field of intervention, the means put at stake by the psychologists are various: direct experiments, observations, inquiries, psychological pests such the intelligence and personality tests. Psychology studies the behaviour of the human being and its motivations. It proposes two therapeutic ways: psychotherapy and psychoanalysis (Vincze, 2020a).

Psychotherapy is a therapeutic method which uses the resources of the mental activities in order to treat certain psychological and emotional difficulties in an individual psychotherapy,

the patient exposes their symptoms to the therapist (psychologist) who is trained and has the necessary experience to produce this type of relation. His objective is to help the patients know themselves better, understanding their past better and their relationship with the others, in order to change their behaviour patterns (Vincze, 2020b).

Psychoanalysis is a general theory of the psyche functioning and at the same time a therapeutic method based on the exploration of the unconscious. Through verbalization, it allows the patient to seek and find the trace of the fundamental experiences lived in the past and hidden in the unconscious. The treatment consists in conversations of various duration from one to three hours per week between the clinician psychologist and his patient.

Knowing to cure your own health means first to address to the physician or psychologist with full awareness, to understand well what they indicate you and to follow correctly their prescriptions.

CONCLUSIONS

The problem of aging preoccupied the researchers a lot. Several theories and hypothesis have been issued regarding the causes of aging.

According to the wear theory, the aging appears due to the impact of the damaging factors on the organism, weakening its resistance to the aggressions which weaken its adaptation mechanism. The pathological states of wear, especially the chronic ones, are considered age acceleration factors, equivalent with the environment's toxic factors. The age intervenes through the simple fact of living, hence aging appears in normal life conditions as well, only later (Vincze & Vincze-Tiszay, 2023).

The first sign of general aging of the organism is the aging of the sexual endocrine glands. Since the biological meaning of life is reproduction, the life of the organisms seems to be programmed for this purpose. The development and permanent regeneration of the organism takes place as long as the biological sense of life can be achieved.

Aging and its final product – death – are an expression of the entropic evolution of systems, hence the energy and structural harmony of the living under the impact of the equalising tendencies and disorganising, proper to the universal entropy, would grow poor progressively from the energetic point of view and would disorganise according to the second principle of thermodynamics.

At the aging of the organism the energetic restoring availability decreases, leading in the end to death. A theory about the "inertization" of the macromolecular reactivity through the progressive appearance of crossed bonds which reduce the chemical reactivity of various macromolecules a lot. Oxidation processes and the reducing ones have also been incriminated as the cause of aging. Another theory implies that the free radicals would produce a blocking, an inertization of the recreation substances from a living organism, action accompanied by important deficiencies in biological process leading to the organism aging.

Further on we present a biophysical model of aging, using the schemes of the category theory.

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