

Institute of Practical Psychophysics

Non-linear Diagnosis Systems

Introduction

The fundamentals of modern physics are quantum theory and theory of relativity. One of the consequences of quantum theory is a conception of intercorrelation of all natural phenomena. The theory of relativity has shown that mass bears no relation to any substance and actually is a form of energy that, as a dynamical quantity, is related to activity and processes.

The theory of entropy logic, an interbranch field of scientific research into matter, has substantially broadened and extended the understanding of information interaction of biological systems. The theory of entropy logic is a very essential part of information theory developed by T. Van Hoven in 1980.

Living organisms – from protozoa up to the human body – are not isolated but open systems exchanging matter, energy and information with the environment. According to L. von Bertalanffy's definition, a living organism is not a conglomerate of individual elements but a certain system having organization and integrity and changing all the time "... the organisms is rather like a flame than like a crystal or atom". Similar to it sounds E. Schrodinger's statement that "the organism is an aperiodic crystal". At the same time living systems appear to be nonequilibrium, dissipative, self-structurizing and self-organizing. Some dominant problems in terms of philosophy bearing a relation to living matter are the phenomena of self-organizing matter and non-linearity of processes.

Considering the proven fact that on a material substratum level the living organism has everything that is required for complete regeneration or at least for adequate compensation, it follows that aging processes and evolving chronic pathologies and diseases can be directly accounted for by the body's loss of information which is needed to form the appropriate control signal. Hence, the self-regulation in a living organism is based on information exchange and on the corresponding formation, transfer and reception of control information signals.

Extensive research has shown that the primary information carrier both within a biological object and between individual bioobjects, including human beings, proves to be electromagnetic radiation (EMR). The information transfer process in itself appears to be energetic, spatial and temporal. Being an open system, the living organism interacts with external as regards the biosystem electromagnetic fields and radiation, and the exogenous influence is adopted by the organism and joins the circumvolution of "information metabolism".

The possibility of developing an electromagnetic generator that can offer the biosystem a certain functioning algorithm is based on the fact that electromagnetic radiation is able to introduce information into the encephalon directly without common sensory organs involved. Perception, transformation and utilization of an influencing external physical stimulus is a rather complicated and many-sided process. It is possible to purposefully influence this process only with many factors taken into account, ones that are related to laws and phenomena of relativistic physics, entropy logic, synergism and chronobiology.

Part 1

Principles of information exchange in a living organism

The sources of originating activity and self-movement should be traced to the phenomenon reflecting the influence of the environment, that is in open systems. Activity and self-movement are caused by the object's variables deviating from normal values when the object interacts with the surroundings. It is the deviation that is responsible for its reflection, information and feedback which in the long run form loops of information circulation producing functional systems. According to the research, the space-time structure of outer macrocosm, through a number of continuously recurrent forces, has transformed into chemical continuum of molecular microcosm of living beings and contributed to the conversion of chemical structures to functional ones.

The conformities of higher levels of matter development one way or another comprise the conformities of lower levels but are not by any means reduced to them. So it proved to be unfounded to account for all forms of development (motion) by mechanical phenomena and for all conformities to natural laws by physical or physicochemical phenomena. The most common manifestation of evolution is in steadfast information accumulation and its increased use. Information is a negation of entropy; it is communication and association in the course of them indeterminateness gets eliminated; as a matter of fact, it is reflected diversity. According to the theory of entropy logic, quantity of information, like quantity of matter or energy, proves to be one of the fundamental characteristics of natural phenomena and entropy proves to be a measure of information quantity.

Animate or inanimate matter consists of the same elements of Mendeleev's Periodic Table of elements. In distinguishing between animate and inanimate matter the most important thing is a type of structure, provided the corresponding structure has a certain function. Transition from life to death is possible only for animate matter with the conservation of the existing structure but with the interruption of life securing functions.

Among common properties of animate matter is the ability to reproduce itself. However, the main distinctive feature is an individual information monitoring structure with every living organism so long as self-reproduction is not possible without genetic transmission of information and development programs.

It is common knowledge now that the interaction of external stimuli with living substance takes place on a cell level. The minimum volume of information that is needed to perform all the functions inherent to the cell should not be less than 10^{23} - 10^{25} bits. However, this does not correspond to the information possibilities of the cell nucleus which do not exceed 10^{10} bits. The paradox – an enormous volume of information that the cell nucleus is not able to accommodate and global ‘being in the know’ of every cell about what is going on in the organism – leads to the suggestion that there exist and function peculiar information complexes. Developing this conception brings us to the conclusion that there are information – monitoring complexes of biostructures, the bioobject as a whole, the noosphere (biosphere) of our planet and so on, ecumenically.

Answers to the question about the capabilities and means of outside information influence on bioobjects and on man in particular lie in the right understanding of the control mechanism as a specifically organized form of matter motion, as a mechanism realizing the program of development and functioning of the human body, as a process of information synthesis and hierarchy of this process.

1.1. Information continuum of the human body

The primary structural functional unit of the living organism is a cell. All changes significant for a bioobject start or stop on a cell level, the cell is a universal complex, the initial and final stages of realization of all biological processes.

The information continuum in a bioobject is associated with two functioning channels: a slow biochemical channel (tactical ways) and a fast physical channel (strategic direction). The fastest chemical reaction take 10^{-6} s, while electron polarization of dielectrics, which are biopolymers, takes 10^{-13} – 10^{-11} s, ion polarization – 10^{-13} – 10^{-11} s and orientational polarization – 10^{-10} s.

The use of chemical substances to influence man with a view of correcting different deviations from normal is mainly related to the development and application of different remedies (pharmacology and chemotherapy). The use of external physical stimuli to influence the human body for therapy and disease prevention is a field of theoretical and practical research into psychophysics, parapsychology and entropy logic.

The opinion that a living organism can have direct information exchange with the environment and needs an information synthesis process leads to the conclusion that there is a time interval from the moment of external information stimulus influence to the corresponding response of the organism. For psychophysical influence this interval is minutes to hours, for pharmacological and chemotherapeutical influence it is days to months.

Thus, the information influence on a bioobject with external physical factors involved has a number of unquestionable advantages as compared to the use of chemical factors. So the rest of the survey, analysis and the corresponding findings will only concern physical factors of information influence.

1.1.1. Endogenous forms of information exchange

The physical channel of control and realization of the program of development and functioning of the human body is heterogeneous and is represented by electrical, electromagnetic and acoustic fields and domains of polarization. In terms of matter from atom up to a multicellular organism as regards the functioning of a bioobject the most essential thing is electromagnetic interaction. The intensity of the interaction is determined by the corresponding constant bond which, in terms of electromagnetic interaction, is an electric charge.

All the processes in the bioobject on an atomic-molecular level start from changing the value of electric charges due to the fact that macromolecules are semiconductors or dielectrics, many of them are dipoles capable of forming domains and also due to the fact that macromolecule structures have properties of liquid crystals or electrets. With a change in the electric status of macromolecules, these properties make it possible to generate electromagnetic and acoustic fields and waves. In terms of energetic levels of quantum electrodynamics this can be given the following explanation. The primary accumulation of energy by the electrostatic field as a result of energy capacity of metabolism takes place on a E level. So a non-equilibrium static state arises which causes the ion channel to open and electric current to originate. Ions start moving in an organized string which causes the swinging of the mechanical vibrations of the macromolecule. This results in the energy accumulating as the energy of mechanical vibrations – an M energy level. Non-linearity of mechanical vibrations with a rising amplitude can lead to the excitation of excitons which correspond to an R energy level. From this level energy dissipation goes on by emitting electromagnetic waves.

This kind of energy level structure is a classic three-level non-equilibrium system which is a source of laser emission. An external resonator is needed to realize this structure. However, in cell membranes there may exist conditions in which inverse population can cause laser type emission

without an external resonator. Experimental data are available about chromosome DNA acting as a biolaser with changing wavelengths of the fields emitted by them. It's a proven fact that macromolecules of biosystems are able of accumulating photons on account of excimer and exciplex excitation and that the wavelength (λ) of stored photons is within 250-900 nm.

In 1977-1988 H. Frohlich theoretically substantiated and provided experimental proof that living cells can produce electromagnetic fields. He developed a common theory of coherent oscillations in biological systems. A.S. Davydov (1986) described excitation, delocalization and motion of electrons along peptide chains of protein molecules as an elongated wave –soliton which completed Frohlich's model. These fundamental theories have broadened and extended the understanding of the conception about a code hierarchy of biosystems. It has become clear that endogenous fields of the organism of Frohlich-Davydov kind are automatically modulated by the structure of a biosystem and carry the corresponding information load.

Theoretical and experimental elaboration by P.P. Garyaev and coauthors gives grounds to assert that the fundamental principles of biological system code hierarchy are infrastructures of extracellular matrices (ECM), cytomembranes, cytoskeleton and cell nuclei. All changes in a living organism, in the first place, are associated with changes in these structures. DNA, ribosomes and collagen (the principal constituent of ECM proteins) are main information biopolymers. Among them there is information exchange in an epigenetic mode through physical channels of non-linear electromagnetic oscillations. Moreover, the generators and acceptors of information waves within bioobjects are various liquid crystal structures and intracellular water with the ability of forming fractals.

The main distinctive feature of a living organism as an open thermodynamic system is that the environment interacts with its forms and processes on an information synthesis basis by changing entropy normalization. Entropy as a measure of information of a certain kind of living matter is a sum of a measure of genetic information and a measure of information in processes of self-organization for which the properties of the system's elements are determined by entropy values. As the hierarchy level rises entropy becomes more important as a measure of information that does not affect the level of genetic information (DNA or RNA). When human brain is formed this hierarchy has a level close to maximum with the interaction that determines the brain function not affecting the levels of DNA or RNA. The zero level of the hierarchy of entropy describing the brain function only produces a similar character of neuromediators of the CNS. The community is responsible for inborn forms of behavior and reflexes. 'The computing element' of the brain is based on the principle of information synthesis. To train the brain it is sufficient the body's organs to release normal products of their metabolism.

The nervous impulse originating in the course of evolution replaces direct regulation of the organism (due to a change in the conception of products of basal metabolism) by regulation based on universal compounds-neuromediators abstracted from the primary functions of survival. Before all else, this, with interaction of external factors involved, makes it necessary to make an information synthesis – e.g. to relate incomparable causes and effects directly, on a biochemical basis.

Thus, the endogenous information continuum in a bioobject is produced with physical (electromagnetic and acoustic fields) and chemical (mediators) factors. Anyway, the leading part's assigned to physical factors because of an accurate, global and extremely fast relationship established among biostructures in the course of interaction for their excitation and information synthesis. In addition, there is nothing to rule out the possibility of frequency-selective electromagnetic radiation acting as mediators in the functioning of the brain.

1.1.2. External stimulus influence on endogenous information factors

The possibility of radical change in variables of endogenous information factors of bioobjects due to external influence is predetermined by physical laws. The physical channel controlling and fulfilling the programs responsible for the human body's development and functioning (electric, electromagnetic and acoustic fields and domains of polarization) is very sensitive to the influence of external physical stimuli. This can be accounted for by the fact that the main element in the trigger mechanism of the body's response to an external factor is a change in the electric status of a cell (group of cells) resulting from a change in the electric charges of macromolecules, and endogenous synthesis and the neuromediators formed depend, in the first place, on the quantity of electric energy and the mechanism of its dissipation.

However, the apparent simplicity and optimum character of endogenous information exchange do not suggest an easy way of introducing any kind of information into the bioobject. The mechanism of control and implementation of the programs of development and functioning of the human body consists in calculated multicycle information transformation in two interrelated feedback-closed (FB) circuits, and in functional implementation both to maintain the stability of biosystem control (first FB circuit) and to develop and further enhance the systems organization by selecting and collecting information (second FB circuit). The first circuit is a circuit of 'operative information' or self-regulation – a reaction of living substance to every isolated act of influence to maintain the stability at the present moment; the second one is a circuit of 'structural information' to select and store multiple 'useful traces' of influence, a circuit that builds up multiformity and forms it into a certain structure.

The infinite radius of electromagnetic coupling, the maximum speed of propagation in an electromagnetic radiation medium as compared to other known physical factors and the possibility of transforming it in a bioobject into other physical factors make it possible for electromagnetic radiation to promptly and efficiently influence the endogenous information factors of a bioobject making it act as the main external factor in terms of information effect on bioobjects.

1.2. Chronobiology and energy capacity of functioning bioobjects

The algorithm of living system functioning normally comprises such successive stages as structure renovation involving matter and energy consumption and energy generation and consumption according to controlling information; energy exchange control based on converting signal information into control commands and time concordance of the structural, energy and information levels of functioning. At the same time, the development of a pathology consecutively passes through the following stages:

- time mismatching of different levels of biosystem functioning;
- information flow disturbance in the body;
- energy; exchange disturbance;
- metabolism disturbance and structure disintegration.

Hence, any kind of biosystem malfunctioning starts off with time mismatching of different processes which causes distortion of information commands which control these processes.

Biological rhythms are understood to be non-linear, periodically recurrent variations in the intensity and character of biological processes and phenomena. The terms 'resonance' and 'synchronization' used in the science of rhythm have a different sense. With reference to a bioobject 'resonance' is pertinent to structure while 'synchronization' has reference to the bioobject's function.

The main peculiarity of living systems is excess energy generation in metabolism and accumulation of the surplus. Primary energy generation is related to P. Mitchell electrochemical cycles (1961). The energy capacity of metabolism is unique. With all kinds of living matter it is actualized on the basis of earlier reserved electric energy with adenosine triphosphate (ATP) involved.

All forms of life depend on an amount of information determining the common basis of metabolism energy capacity for all of them. The information defining the role of ATP in these processes is practically indispensable for higher forms of life. This confirms that the process of information transfer is energetic, spatial and temporal and that chronobiological and energetic aspects of bioobject functioning are inseparably linked.

1.2.1. Frequency range of operative rhythms of structural elements and functional systems of the living organism

The dividing line between the structural elements and functional systems of the human body runs on a cell level as the cell is a primary functional system. In a living organism there are two closed systems, one of which is 'inserted' into the other – the cell (cells) and the organism as a whole. The latter has subsystems as its constituents. And the cell is a system, although subject to common correlative influence and relations, yet, at the same time functioning according to its own laws and in some cases (particularly when a pathology is the case) getting out of the control of that common correlative influence.

The functioning rhythms of structural elements of living matter are within a high frequency range of 10^8 - 10^{15} Hz. This is probably related to the evolution of all Earth's living beings owing to solar radiation or, to be exact, to some of its specific spectra, reaching to the terrestrial surface. In our planets atmosphere there are two 'windows' through which sun rays get to its surface.

1. - optical 'window' letting in some of the ultraviolet rays ($\lambda = 290 - 390$ nm), visible ($\lambda = 390 - 760$ nm) and infrared ($\lambda = 760 - 1500$ nm) electromagnetic waves.
2. -radiowave 'window' through which electromagnetic radiation with a wavelength of 1 cm to 50 m passes.

Experimentally established have been approximate resonance frequencies of some structures of the living cell: somatic cell – $2.39 \cdot 10^{13}$ Hz; somatic cell nucleus – $9.55 \cdot 10^{12}$ Hz; mitochondria from a hepatic cell – $3.18 \cdot 10^{12}$ Hz; human cell genome – $2.5 \cdot 10^{13}$ Hz; interphase chromosome – $7.5 \cdot 10^{11}$ Hz; metaphase chromosome – $1.5 \cdot 10^{13}$ Hz; DNA – $(2-9) \cdot 10^9$ Hz; nucleosome – $4.5 \cdot 10^{15}$ Hz; ribosome – $2.65 \cdot 10^{15}$ Hz; cell membranes – $5 \cdot 10^{10}$ Hz; cytoskeleton – 10^{11} Hz. The presented data completely coincide with frequency characteristics of electromagnetic waves emitted by the sun and reaching to Earth's ground.

The operative rhythms of man's functional systems have a low-frequency range of 0.4 – 8.2 Hz. For instance, the rhythm of gastrointestinal electric potential is 3.8 – 4.6 Hz, the respiratory rhythm is 6.3 – 7.6 Hz, the cardiac rhythm is about 3.2 Hz, the rhythm of electric activity of the nervimuscular elements is 2.6 – 6.5 Hz. The rhythm of encephalon control signals is 0.5 – 13 Hz. The vital functions of an organism need steady operative rhythms of functional systems and their freedom from external influence. These purposes are served by the dispersion of the human body's tissue electric properties which is associated with the state of charged particles when affected by electromagnetic fields and different frequency radiation – the dynamics of specific electrical

conductivity, capacitance and plasmalemma impedance enables to practically completely shield low-frequency electromagnetic radiation (up to 10^3 Hz) which does not penetrate cells nor does it cause intracellular ion transfer.

1.2.2. Energy capacity of bioobject metabolism

Metabolism, synonymous of matter transformation, is a total combination of chemical and physical changes occurring in a living organism and ensuring its vital functions as interrelated with the environment. The main specific functions of metabolism are: 1. derivation of energy from the environment as chemical energy of organic substances; 2. conversion of exogenous substances into 'building blocks', e.g. antecedents of the cell's micromolecular components; 3. assembly of proteins, nucleic acids, fats and other cell components from those building blocks; 4. synthesis or disintegration of those biomolecules that were necessary to fulfill various specific functions of a particular cell.

The difference between the energy capacity of living matter and a heat engine lies in the fact that it uses free but not internal energy. The principle of structural complementarity of a living system (striving to have no byproducts in chemical reactions) makes a class of compounds – adenine nucleotides, and among them, for most living beings, man included, the sole substance adenosine triphosphate the principal working body in life energy cycles. The unique properties of ATP and freedom from entropy as an independent variable for free energy make the energy cycles of metabolism practically fully determined processes with reference to initial and terminal states. Processes of generation of energy and its dissipation do not depend on one another directly, the self-adjusting balance between the energy produced and its dissipation is not possible, at the same time, for comprehensible reasons it is incompatible with life for the dissipation to go beyond energy production.

In metabolism excess energy is produced and the surplus is accumulated. The elementary kind of accumulating is origination of a transmembrane potential and the energy of its electric field.

The energy capacity of metabolism is of the kind that it secures electric reserve wherever possible. The consumption of the stored electric energy goes on in two ways: in the first one the electric current flows through ion channels producing heat and starting regulated wave processes; in the second one non-equilibrium processes of chemical compound synthesis are initiated, especially of ATP and neuromediator synthesis.

Despite the fact that the energy of external physical stimuli affecting the bioobject is not assimilated directly and does not join metabolism it has an essential effect on ATP synthesis and on some specific functions of metabolism because of a change in the electric status and transfer of

molecules into an agitated state in terms of physical processes, and because of the influence on weak atomic-molecular links and conformational changes in macromolecules.

The quantity expressions of energy variables of different interacting structures of bioobjects have been determined with enough accuracy – the energy of weak atomic-molecular interactions (van der Waals' forces, ionic, ion-dipole, hydrogen and hydrophobic links) which are constantly recombining in the course of metabolism, is 4 - 400 kJ/mol or 0.04 – 4.0 eV; the energy of different conformational changes in macromolecules is 10 – 90 kJ or 0.1 – 0.9 eV; the energy of conformational changes with interaction of the mediator with cell membrane receptors is about 25 kJ/mol or about 0.2 eV.

As for the energy variables of vital functioning systems starting from a cell level, the quantitative values of energy required for normal functioning are still lower – 0.005 – 0.05 kJ/mol or 1.06 – 10.5 eV.

Thus, in the first place, the energy capacity of bioobject metabolism is related to the electric status of structures with different complexity which plays the leading part in both energy accumulation and its dissipation.

1.2.3. Possible ways of influencing bioenergy capacity and chronobiological processes

The mechanism of control is a specifically organized form of matter motion that consists in calculated information transformation with a particular purpose. Classic open systems largely characterize the interaction of energy and an amount of information. However, in living systems there is no exchange between energy and information nor are there direct information flows from outside which could by themselves be of vital importance to life processes as they use free energy for their metabolism where entropy is not an independent variable. However, energy dissipation in a bioobject is closely related to external information influence.

As it has been mentioned before, non-linear processes are periodically recurrent variations of a certain kind and intensity in structures and systems of a bioobject in vital activity processes. A wide, evolution-dependent frequency characteristic range of varying processes of individual biostructures and a very narrow frequency characteristic range with functional systems of the human body in terms of information – wave continuum have the following objective reasons:

- 1) there is a multitude of structural units in the bioobject far fewer are there functional systems, however vital algorithms of the organism, both in normal conditions and in a pathology, are set by functional systems.
- 2) H. Frohlich and A.S. Davidov theories give an explanation of the fact that frequency characteristics of the affecting factor in the whole hierarchy do not need to be modulated

by the rhythm of functioning biostructures. Also, of the primary excited state, caused by one influence or another, do biomolecules, which can be described as a string of non-linearly linked oscillators, go out by emitting electromagnetic waves according to Fermi-Pasta-Ulama mechanism of return. The characteristic feature of that kind of mechanism is that the energy of the initial disturbance of non-linearly linked oscillators is not distributed among all possible oscillating states of the string (thermalization process) but, on being distributed among individual higher oscillating harmonics, after a while returns to the distribution of oscillations similar to the initial disturbance. As the reradiation is performed by a complicated oscillating system – a biomolecule, it leads to the origination of special electromagnetic waves –solitons, peculiar wave packets having a complicated oscillating structure with a spectrum of combinational frequencies, of coherent radiation on account of fractal properties of biomolecules. Hence, on a level of individual biostructures, the resonance arises due to a soliton wave formed in the biomolecule reradiation of the initial effect in which the bioobject itself has set a combination of resonance frequencies required for the corresponding structures owing to Fermi-Pasta-Ulama physical phenomenon of return. Any external physical factor affecting the bioobject in the first place causes a change in the electric status of biomolecules and cells in the area of influence owing to a pyroelectric, photoelectric and piezoelectric effects and the restructuring of domains of polarization. That is the main link in the trigger mechanism of all subsequent responses of the bioobject including the abovementioned processes.

Thus, it is possible to influence biological processes with different directivity by controlling the synthesis and disintegration of macroergs (ATP) owing to a change in the transmembrane potential; by influencing some specific functions of metabolism; by synchronizing or by imposing the corresponding oscillating process frequency on the bioobject functional systems to trigger the biological and behaviorial reactions ensuring the desired result.

Part 2

Common regular principles of purposive selection of variables of information influence factors

There are several channels engaged in forming the mechanism of implementation of the programs of development and functioning of the human body. The first one is hereditary, it contains parental information. The second one refers to the effect of the environment. Chemical substances,

coming into the organism from outside, influence it largely through the second channel. In certain conditions they can influence the first channel as well. External physical factors, too, chiefly influence through the second channel of implementation of the corresponding programs. However, in a more pronounced form, as compared to chemical substances, they influence the first channel as well which then radically differs from the chemical substances affecting the second channel.

According to kinds of energy and types of its carriers external physical factors affecting man, both natural and artificial (preformed), can be divided into 6 groups. They are electromagnetic radiation, electric currents, electric fields, magnetic fields, mechanical and thermal factors. If you put on the list of requirements in selecting a factor to exert information influence on man with a preset purpose some of its properties like universality (use of a certain limited set of means of achieving different goals), maximization (the highest speed of distribution in different media achievable in nature), action radius of the factor, you have every reason to say that all of those requirements can only be met by electromagnetic radiation.

A great accuracy, a global character of influence in the course of excitation and information synthesis in electromagnetic radiation, a possibility of bringing about great changes in the internal medium of the body in short periods (within minutes-hours) confirm the incontestably right choice of this factor for information influence. By controlling information synthesis through addressable excitation of the biosystem with electromagnetic radiation involved it is possible to influence metabolism and psychological or behavioral responses.

Using electromagnetic radiation as an information factor makes it necessary to correctly fulfill the following tasks:

- to make a well-founded choice of the wavelength of electromagnetic radiation;
- to determine the variables of amplitude and frequency modulations in accordance with the specified purposes of influence;
- to determine energy irradiance and energy exposure for the specified purposes;

On this basis it is possible to formulate the principle of information action – the achievement of the desired result with an external information factor involved depends on the rhythm synchronization of the functioning factor and the corresponding functional system or on a lasting effect of a certain rhythm of the oscillating process imposed by the operative factor on one or another functional system of the human body with optimum energy variables of this factor.

2.1. Principles of picking out frequency characteristics

In establishing fundamental principles for defining and picking out frequency characteristics of the information action factor with a predicted result one should be guided by laws of physics and

biophysics, rules of theories of open systems and information science, synergism and chronobiology with application and generalization of some up-to-date methods of mathematical analysis and physico-mathematical simulation.

With reference to the selected factor – electromagnetic radiation – it is necessary to initially define the appropriate wavelength of radiation which would meet the requirements of the information action.

The first frequency characteristic is a natural frequency of one or another spectrum and a wavelength of electromagnetic radiation. The limitations in the option are predetermined by the self-shielding of biotissue from low-frequency (under 10^3 Hz) electromagnetic radiation and evolutionary adaptivity of bioobjects to radiation with a wavelength of 290-1500 nm 1 cm – 50 m. Also, the limitations are predetermined by quantum energy of electromagnetic radiation – so, at the upper limit of the electromagnetic spectrum (between medium-wave and short-wave segments of the ultraviolet area) the quantum energy is 400 kJ/mol which exceeds the value required to break strong bonds accounting for the chain structure of biopolymers. Thus, the wavelength of electromagnetic radiation for information influence on the bioobject should be in the optical and radiowave bands (under 50 m), and the natural frequency of this wavelength will be the carrier one. In information action the carrier frequency is of interest from a standpoint of three main things. The first one is the maximum probable penetration depth of the appropriate wavelength in the bioobject tissue, the second one is a bandwidth of combination choice of a soliton wave in reradiation by biotissue owing to Fermi-Pasta-Ulama mechanism of return; the third one – for this kind of bioobject structures the carrier frequency is a resonance one.

In the overwhelming majority of cases (quite often in 100%) the required volume of information is introduced into bioobjects through electromagnetic radiation owing to its modulation. Modulation is an alteration in the amplitude, frequency and phase of the harmonic oscillation according to a certain law to introduce the required information into the oscillating process. Modulation of oscillations is a slow, as compared to the oscillation period, change in amplitude, frequency or phase of oscillations according to a certain law. Information transfer with the aid of electromagnetic waves owing to their modulation is only possible in the low-frequency band of these waves – 1.8-9.6 Hz.

Thus, the modulation frequency is an information frequency carrying the main volume of the corresponding information.

With reference to the chosen wavelength band (from long-wave ultraviolet radiation to decimeter waves) whose natural frequency can be used as a carrier frequency of information action, the depth of their penetration in the biotissue of a living organism is distributed in the following way. Decimeter waves (with a frequency of 300-3000 MHz) penetrate tissue with high water

content 4 cm deep, with low water content – up to 26 cm, centimeter waves (with a frequency of 3-30 GHz) penetrate respectively up to 2 and up to 11 cm deep. Millimeter waves (with a frequency of 30-300 GHz) penetrate about 0.2-0.6 mm deep; far-infrared radiation – within 0.2 mm, near infrared radiation – within 5 cm deep (laser radiation – up to 6 cm or more). In the optical band of electromagnetic radiation from the ultraviolet to orange segments of the spectrum the depth of penetration in biotissue gradually increases from 0.1 to 2.5 mm and with the red segment of the spectrum it reaches 2.5 cm. Proceeding from this data, in opting for a carrier frequency, of interest are decimeter and centimeter radiowaves (with a frequency of 0.3-30 GHz) and near infrared radiation in the optical band (with a frequency of $(1.2-3.95) \cdot 10^{14}$ Hz). In terms of frequency resonance of electromagnetic radiation and biostructures the optimum results are achieved by using superhigh and extremely high (SHF and EHF) radiowaves respectively and infrared radiation of the optical band as the fixed resonance-based frequencies are $(3.5-4.0) \cdot 10^{11}$ Hz for erythrocytes, $5 \cdot 10^{10}$ Hz for cell membranes, 10^8 Hz for cytoskeleton, 10^{12-13} Hz for proteins and $(2-9) \cdot 10^9$ Hz for DNA.

When picking out a carrier frequency one cannot disregard the research data indicating that the electromagnetic radiation with a wavelength of 1.8-2.1 mm is a physical factor that starts interaction between two organisms.

In modulating electromagnetic radiation it is possible to alter such variables as amplitude, frequency and phase of the harmonic oscillation. The most important thing for information effect on a bioobject is a frequency variable of modulation which is accounted for by the following objective reasons. With an optical band a light wave amplitude is closely related to light intensity, e.g. to an energy variable. An advantage of frequency modulation over amplitude for radiowaves is high noise immunity, and a high-quality signal transmission with frequency-modulated oscillations takes place in low-frequency wave band (from 1 to 10 Hz). With phase modulation a modulated oscillation is identical with a frequency-modulated one.

The principles of information frequency selection are based on concepts, models and methods on entropy logic and laws of synchronization of oscillating processes. Models of entropy logic are models of non-linear non-equilibrium systems subject to fluctuations and it is this that happens in complicated biosystems. At the moment of transition the ordered and disordered phases differ from each other so unimportantly that it is fluctuations that convert one phase into the other. If there can be several stable states in the system, the fluctuations select just one of them. It is substantiated, that all varying objects have a tendency to synchronization with one another. Anyway, established are phase correlations multiple of integers and the force of interaction can be as small as desired. One of the main properties of synchronization is its dependence on the partial frequency of object oscillations – with close frequencies synchronization starts without other similarity elements present, and deteriorating synchronization behavior is associated with an increase in the order of

synchronization mode (a decrease in the area of mode 'attraction'), the optimum synchronization is in the ratio 1:1. Another property of synchronization is the effect of frequency average – the averaging frequency of synchronization is at all times lower than the highest one and higher than the lowest frequency of object oscillations. Among other elements of entropy logic theory a possibility of 'trapping' external frequency by the system should be pointed out, moreover the leading generator is a generator with a maximum oscillating frequency – it captures all of the rest system generators in synchronous operation.

'The band of synchronization' gets wider in transition to non-linear systems. In complicated non-linear systems generating several frequencies oscillation synchronization is possible in different combination frequencies of the systems.

It is necessary to synchronize the information frequencies of the affecting factor with normal rhythms of life-sustenance of bioobject's functional systems. If any other aims are pursued it is necessary to impose a certain rhythm of the oscillating process with laws of synchronization taken into account. However in both cases the information frequencies are in the extremely superlow-frequency band according to the Classification of the International Communications Regulations (1976); quite often in both cases there is a need for a compound modulated 'sketch' of information frequencies. Anyway, the composition of compound modulated frequencies makes it necessary to take into account laws of symmetry 'golden proportion', golden wurf' and rules of Fibonacci sequence.

With reference to the carrier frequency of information action of great interest are up-to-date data of physico-mathematical simulation and physico-mathematical substantiation of the existence and importance of longitudinal electromagnetic waves [20]. Special consideration deserves the assertion that longitudinal waves have a high penetration ability, with reference to conductive bodies as well; that the propagation speed of longitudinal waves can be as high as $1.88 \cdot 10^4$ s, where s is light speed; that the energy quantum of the longitudinal wave with this propagation speed is 5 orders higher than the energy quantum of transverse electromagnetic radiation.

2.2. Principles of determining required energy variables of influence

To reach the desired clinical effect with an external physical factor in action it is necessary to selected optimum energy variables with appropriate synchronization of the action.

There is experimental proof [45] that physiologically important responses to electromagnetic radiation develop with power flux density as low as $5 \mu\text{W}/\text{cm}^2$ and that human electromagnetic field sensitivity starts with a power density of $5 \cdot 10^{-4} \text{ W}/\text{m}^2$.

The data is available, that the energy capacity of cell structures for non-thermal interaction is 10^{-10} W/cm² or 10^{-5} eV. Potassium channels, a universal system of prompt reacting in the integrated cell system, are sensitive to electromagnetic radiation with a power flux density of 50 μ W/cm². Electromagnetic radiation energy quantum with a wavelength of 65 cm (with a frequency of 460 MHz) is $1.9 \cdot 10^{-6}$ eV, with a wavelength of 2 mm (150 GHz) it is $6.2 \cdot 10^{-4}$ eV and with a wavelength of 0.85 μ m ($3.5 \cdot 10^{14}$ Hz) it is 1.45 eV. Comparing the indicated values gives grounds to definitely state that in an optical electromagnetic radiation band there is enough energy of quanta as it is to initiate biological reactions with a superminimum power flux density, and in a lower frequency band this value can't be more than an order higher than the experimentally determined effective value (5 W/cm). In addition to the above stated facts the data of S. Smith's research can be cited – an energy flux density of about 3 μ W/m² directed at coherent water provides the same internal energy density as the flux with a density of 100 W/m². Anyway, coherence is a coordinated proceeding of processes. Living quite meet these requirements, hence their substrates may have coherence properties.

2.3. Practical aspects of information – wave influence on the human body with diagnosis purposes

G. Celier said, 'There are two ways to a discovery – one lies in strivings after more precisely defined detailed elaboration and in the deepest possible penetration into the subject with the help of state-of-the-art analytical equipment; the other one is simple surveying of the subject from a new standpoint which provides an opportunity to reveal facets never known before. The former needs resources and proficiency while the latter is in no need for them, actually of help here is just freedom from prejudices and from an ingrained habit of thinking in a convention a way which results from many years of research work. One can add V.M. Dielman's statement to what has been said,...' those who seek answers to questions lying beyond their specialized field often make a valuable contribution to science development thanks to an unbiased approach'.

Methodology of information action through electromagnetic radiation does not have much in common with conventional diagnosis. The difference lies in the ideology of methods – traditional medicine has so far professed the theory of nervosism and the neuroreflex – endocrino –humoral mechanism of interaction of external physical factors with a bioobject without bringing up the problem of information metabolism through physical communication channels of the human body.

To understand the mechanism of information influence of electromagnetic radiation of the corresponding variables and work out techniques for its use with diagnosis purposes it is important to have the right orientation among terms and concepts. In the first place, with reference to external

physical factors, specifically to electromagnetic radiation one should differentiate between energy-informational and pure information influences which are quite often regarded as identical. According to A.S. Pressman's definition, in energy-information interaction the energy absorbed by a biosystem is a carrier of information acting as a signal and causing a response of the biosystem owing to its own energy resources. Pure information interaction of biosystems with the environment is isolated from their energy exchange. Our substantiation of energy variables of information – wave influence is in complete accordance with this definition, e.g. with pure information interaction.

The desired effect of information action depends on the technical facilities of the radiation generator and methods of its application with strict observance of the basic principle of this methods – synchronization of rhythms or a lasting effect of imposing the rhythm of the oscillating process on the biosystem with optimally minimum energy variables of the effective factor.

2.4. Potentialities of up-to-date prospective medical equipment

The quest for selective resonance frequencies with a simultaneous substantial decrease in output energy variables of the affecting factor has enabled to produce a new class of diagnosis apparatus which has come to meet the requirements for at least energy-information action.

The beginning was marked by the introduction laser medicine methods into clinical practice using low-energy laser radiation. The earliest generator of this physical factor was a helium-neon laser but its technical facilities did not make it possible to produce output radiation power over 25 mW. Because the principal methods were distant the power flux density on the surface exposed to radiation corresponded to 0.3-10 mW/cm². Initially the pillars of Russian medicine were sceptical about this class of apparatus because of its low energy power. However, ample factual material about an adequately high efficiency resulting from the effect of low-energy laser radiation made them recognize this factor as effective, anyway, now the methods of laser medicine are widely used in clinical practice. Yet, the employed energy variables and different frequencies of radiation modulation have not so far met all the requirements of information – wave influence. Nevertheless, the prospects for the use of electromagnetic radiation in an optical band, especially laser radiation are promising enough. In the frames of the mechanism of information influence on a bioobject the optical band has been assigned a special part. It has already been noted that cell populations are effective storage elements with an active mechanism of storing photons with a wavelength of 250 to 900 nm and that the efficiency of the storing resonator is very high. And this is a peculiar energy 'pumping' of major information biopolymers and it has a direct **system-organizing** influence on a bioobject.

The next stage in resonance medicine with low energy variables of influence was theoretical substantiation and experimental and clinical research into the interaction between the bioobject and extremely high frequency electromagnetic radiation (a frequency band of 30-300 GHz, a wavelength of 1-10 mm) – EHF-radiation with bioobject energy exposure (a power flux density) of 0.01-100 mW/cm². Resonance frequencies with a wavelength of 5.6 and 7.1 mm were determined and grounds were substantiated for the use of a large number of analogs of technical devices (EHF-devices like Yav-1) in the case of one or another pathology present. However, counting only on the sharp resonance character of influence of one frequency (wavelength) on a bioobject and comparatively high power flux density (not less than 10 mV/cm²) of EHF-radiation still do not meet the essential requirements of information medicine and the principle of information-wave influence. This has become a spur to further quest for ways of development and improvement of the apparatus and methods of EHF-influence.

The adoption of oriental methods of reflexotherapy made researchers and practical workers consider the possibility of replacing a metal needle or an absinth cigar as a factor of influence, by electric current and electromagnetic radiation. Anyway, some questions have arisen as to probable and required variables of these influencing factors. On this basis an entire field of electropuncture diagnosis has come into being using different methods (Foll, Nakatany, Nechushkin) which are based on the measurements of skin electroconductivity in bioactive points (BAP). Presently there is no experimental data available about an actual effective substrate of BAP. The most objective substantiation of BAP morphology is P.P. Garyaev's conception of intercellular reticulum as a specific signal system of the human body, including BAP. Intercellular reticulum or intercellular substance can play the role of a peculiar supramolecular analog of neuron networks which ensures a directed introduction of information into certain cellular and tissue associates including 'matrices of acupuncture competence'.

On the basis of electropuncture diagnosis and the dynamics of its indices in the course of EHF-action the output energy variables of radiation were substantially reduced with a maximum value of 0.1 mW and new generators with a wide-band frequency (wavelength) of radiation were developed (devices of the series Electronica, EHF - 52-62 GHz and devices of the series Kovert – 53-78 GHz). The ones with a still wider band are devices Porog-1 (30-300 GHz) and Minitag (30-62.5 GHz) with a superminimum output power which with a contact-based technique, provides a power flux density of about 10-17 W/cm². This made it possible to optimize energy variables in terms of the information action requirements, however the question of action synchronization remains unsolved.

The development of electropuncture methods in terms of energy information action on man has led to the making of apparatus complexes with feedback proceeding from a change in BAP

electric status. These are devices Ellada-4, Prognos-6, Prognos-7, Prognos-8, Vika-3 and devices Imedis-Foll, Imedis-BPT. However, without discussing the diagnostic importance of methods of influence it should be noted that electropuncture requires an extremely high proficiency of the operator who is supposed to embrace the functions of the entire diagnosis service, to be a strategist in picking out an action and a subtle tactician in dynamic control. More simple methods, also based on changing electric skin potentials, with twin contact electrodes for the palm surfaces of hands and sole surfaces of feet, are methods of bioresonance therapy with Bikom and Betta-3 devices involved. Despite a number of major differences on a constructive and method plane among the above-mentioned methods of influence based on feedback the recorder physical factor affecting a bioobject is an electric potential or to put it more plainly – electric current. A continuous diversity of electromagnetic phenomena in the human body – biological electromagnetic continuum – is interrelated with vital function processes, and the electric status of the integument and BAP reflects this diversity. By changing this status with the help of the above-mentioned apparatus methods one can promote the regulation of the internal control system. Anyway, the unequivocal assertion about a bioresonance effect and synchronization with the appropriate biorhythms is rather problematical. More accomplished in terms of information-wave influence are low-energy ‘Nov’ apparatus with SHF-action and a generator of special electromagnetic signals (GSEMS). The carrier frequency in the apparatus is radiation with a wavelength of 7.52 cm (with a frequency of about 4 GHz), with a frequency modulation (information frequency) of 10 Hz and an output radiation power of 2 mW. As the methods of influence with ‘Nov’ apparatus in use are largely distant it appears that at a distance of 15 cm from the surface of the patient’s body exposed to radiation (the optimum distance with different methods) the density of the radiation power flux is 15-25 $\mu\text{W}/\text{cm}^2$. For the apparatus the carrier frequency is 4.2 GHz (a wavelength of 7.14 cm) and the information frequency is asynchronous modulation by quasistochastic signal with 20 KHz. All the methods of influence with the help of GSEMS are distant; the power flux density at a distance of 0.5 m from the radiator is 10 $\mu\text{W}/\text{cm}^2$, at a distance of 1.5 m it is 0.5 $\mu\text{W}/\text{cm}^2$.

Unlike Foll’s method of electropuncture diagnosis in which the energy potentials of organs and tissue are measured through biologically active points (BAP) that indirectly (quite often with a serious error) reflect the organ’s state, in the non-linear diagnosis (NLS) method developed by the Institute of Practical Psychophysics (IPP) the state of an organ is evaluated directly owing to the resonance amplification of the radiation of the organ under investigation and by taking the readings in a non-contact way with trigger sensors involved.

To implement the indicated possibilities we have made up medico-technical requirements and technical tasks to originate a new generation of diagnosis equipment based on low-frequency quantum generators and developed Oberon apparatus.

Oberon apparatus is designed to make an express assessment of the body condition by reordered changes in organs and histological structures, exercise dynamic control over the state of homeostasis and forecast stages in treatment and development of complications. The diagnosis apparatus makes it possible for the doctor to substantially cut the time for an express evaluation of the condition of the body as a whole system. The apparatus is designed to record changes in organs and histological structures and it enables:

- to get a qualitative assessment of the functional state of the body in terms of topical analysis;
- to check the effectiveness and results of therapeutic methods employed;
- to assess the adaptive abilities of the body;
- to make an analysis of the dynamics of change in the functional state of the body in the course of treatment;
- to reveal the primary nature of the nidus of functional disturbance;
- to define the character of a pathology using expert systems;
- to assess the main variables of homeostasis.

The apparatus is designed to operate solely in combination with a computer complex based on IBM-compatible computers and the software worked out by the parent enterprise. The apparatus functions according to the principle of amplification of the initiating signal with disintegration of the metastable structures.

Magnetic moments of molecule currents in admixture centers of cortex nerve cells affected by the external electromagnetic field, lose their original orientation resulting in disalignment of spin structures of delocalized electrons which causes in them unstable metastable conditions whose disintegration acts as an initiating signal.

In terms of physics the apparatus is a system of electronic oscillators, resonating at wavelengths of electromagnetic radiation, with their energy being adequate to the energy breaking the dominant bonds which maintain the structural organization of the objects.

The apparatus enables to form a prescribed bioelectric activity of the patient's brain neurons against which they acquire an ability to selectively amplify signals hardly detectible against the static fluctuations (a resonance phenomenon).

The information about a specific temporary organ condition is gathered on a non-contact basis by means of a trigger sensor developed with the aid of new information technologies and microcircuitry. The sensor detects faintly detectible signal fluctuations picked out from the average statistical noise field characteristics and converted to a digital sequence processed by means of a microprocessor to be transmitted to the computer through an interface cable.

The modes of apparatus operation, their adjustment and control are ensured according to the installed program.

The information about the results of a diagnosis procedure for a specific patient is displayed on the monitor screen and is stored on a separate file, on the computer's hard disk and can be transferred to an individual diskette.

The intensity of the magnetic field on the surface of the magnetic inductors is 20 ± 1 mT.

Type of modulation in the magnetic inductor circuit is pulse – width modulation. (PWM).

Current interruption rate range in the magnetic inductor circuit – from 1.8 to 8.2 Hz.

Interruption rate control pitch – 0.1 Hz.

Spacing from 0.5 to 95% with a 5% pitch.

Modulation frequency:

Low-frequency modulation - 240 Hz;

High-frequency modulation – 1.5 GHz.

The sensitive element is a noise generator (used as a noise source is 2Г401B constructively revised diode).

The information signal gets picked up off the sensitive element and passes along an amplifying path.

Differential amplifier gain – 30 dB.

Frequency range for processing information spikes in the noise signal - $10 \div 200$ KHz.

Toggle frequency of the shift register – 1.0 ± 0.1 MHz.

By its functional and performance characteristics the apparatus does not have direct prototypes.

The use of the apparatus in clinics and departments of hospitals and preventive medical institutions will enable to substantially cut the time for performing the patient's complex diagnosis as a whole system. It will enable to evaluate all at once a predisposition, existence and interrelation of different pathological changes in organs, tissues and systems of the patients under investigation. Capital investment can be recouped in twelve months. Presently the apparatus is undergoing technical and medical tests and methods of its application are being processed and worked out in detail.

It can be found quite difficult to apprehend the material set forth in this booklet because it incorporates some aspects of quantum physics, theory of information, psychophysics and entropy logic, wave genetics and synergism. This can be accounted for by the fact that presently there is not any other way to wholly comprehend the effects of the interaction between external factors and the bioobject, specifically the human body because the process is versatile and all-embracing.

Of course, this material does not claim an exhaustive completeness in the description of all the processes and phenomena, their interrelationship and influences on the ultimate result. These are just reference points aimed at comprehending and evaluation of the intricate interaction and also starting points in determining external physical factor influence in order to achieve the effects.

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