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Antropotechnics: Norm in Every Living Thing and Artificial Beings

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Introduction

The monopoly in the field of studying the cardinal problems concerning the optimization of controlling activities and the complex security of human vital functions in all its spheres of being for a long time used to belong to psychology. But during the last decades of the 20th century a new conception has arrived - that is: for solving such global problems we need to organize complex scientific research, based on the interconnection of different sciences. Carrying out these kinds of researches is making absolutely new requirements to the methodology, and at the same time forming new kinds of approaches for solving the methodological problems.

The essential characteristic of the current stage of society's development is its extremely tense rhythm of life. That is the effect of using the limitless multiplicity of technics☼, highly intensive industrial processes, the need to handle tremendous quantities of information of any kind on a daily basis and an active simultaneous human participation in various areas of industrial processes and in the implementation of various vital functions.

A rapid technological advance has led to the extraction of a principal structural unit in industrial process - the computerized complex (the dyad «man - technology»). This dyad got a radical advance in the second half of the twentieth century (and quite often to the detriment of the optimal development and functions of two other dyads of the system «man - technology - environment»: «man - environment» and «technology - environment»).

The most striking example of a rapid progress of the «man - technology» dyad is represented by an urgent problem: «man in the computer-based functional systems of informational technologies». Here the most important factors are: ● ensuring the effective activities of a human operator; ● keeping his functional state in optimum scale boundaries; ● constant control over an operator's functional state and his working capacity in order to prevent emergency situations.

One of the fundamental goals of modern *anthropotechnics* is a problem of preserving the efficiency of a human-operator's activity and of keeping his functional state within the optimum scale boundaries. To reduce the risks of human factor related emergency situations there exist a few ways, which have proven themselves to a good advantage: ● professional selection, diagnostics and testing of operators; ● preliminary training and regular retraining; ● handing over the most routine and monotonous functions from a human operator to an automatic machine.

☼ ***Technology*** - product thinking of man, material realize in productive activity work like means guarantee his needs; artificial inhabited of person; component system «man - technics - environment».

These tendencies, however, will not have solid foundations until we are able to learn how to define exactly the state of extreme tension of mental and physical strengths of a human operator which precedes an emergency. Any crucial and dangerous situation inevitably arouses emotional tension. The complicated vegetal-somatic and biochemical changes are taking place: the hormone secretion increases, the indexes of cardiovascular system and external respiration change etc.

An emotional tension is a composite part of an elaborate complex of adaptation as a human adaptive reaction to the external environment. It creates an optimal level for psychotic, psychophysical and biochemical processses and thanks to that it assists the body to use its resources in a best possible way according to the situation's demands. At the same time, the mechanism of emotional stimulation has its own limits. When they are exceeded, the disintegration of vital processes comes along, together with malfunctions in human psychic activities and behavior.

Going beyond these limits causes the transformation of *stress* into *distress*. Moreover, the definition of this state is important because a long-term tension can have a negative influence on human health. In consequence of a nervous overstrain, a deviation of the body's normal functioning may occur with subsequent cardiovascular malfunctions, manifestations of hypertension, peptic ulcer, neuroses, psychosis and other pathological alterations, which in most cases are irreversible.

The study of the reliability of human activity will be of more effective character if there is a comprehensive and complex research touching upon all levels of interaction between an individual and an environment. In the focus of attention of present-day psychology lies the motivation of human behavior. It is well known that the human activity changes depending on a purpose of its actions (motive). And, thereby, the reliability of the individual's normal activity also changes. This process is being observed especially often under the stress conditions.

We can discuss stress as a complex problem. We can talk about it from the point of view of the wholesome activity of the organism, including bio-chemical shifts, changes in physiological indicators, behavior, psychic functions. Our practice shows us that the biochemical changes under stress show themselves as good during the acuity and as bad during the long-term chronic tensions. It's almost impossible to detect changes occurring during the periods of weak tensions, because the mechanisms of homeostatic regulation level those changes almost at once. As a result of reasons mentioned above, we cannot consider the biochemical changes to be primary among the correlating changes.

Apparently, biochemical shifts present themselves as the basic back-ground for various psychotic and physiological changes.

But any physiological parameter (just like biochemical changes) cannot serve as a reliable indicator of the state of extreme tension. The somatic changes in a greater or lesser measure are liable to arbitrary adjustment. Psychotic categories, unfortunately, badly yield to immediate objective control. As for the indirect methods, applied in such cases, they bring in the elements of subjectivity and do not allow for a possibility of arbitrary influences. The forms of behavior, appearing to be a reflection of the organism's internal changes, also yield to a certain extent to arbitrary adjustment. It is necessary to admit that a sufficiently reliable correlate of tension does not exist in practice.

That is why it is necessary to find an adequate and reliable indicator for the state of stress - to have a potentiality to exert in real time an impact on the state and activity of a human being, working in the conditions of increased tension. Evidently, in the future the molecular-biological characteristics of the state of genetic apparatus may become such a correlate for the assessment of the state of tension. It will provide the harmonious interconnection of various changes in adjacent levels of human organization (psychotic, psycho-physiologic, physiologic, and biochemical), having explained the relations between multi-level systems of the organism and the environment and the reflections of those levels in psyche.

Hans Selye's concept of the *general adaptation syndrome (GAS)* reflects, from the point of view of optimization of integral reaction of organism, the regularities in one of the most important sections in a mechanism of its adaptation. If we approach the theory of stress from this position, we can see that it cannot be considered while being separated from the general reaction of the body as a whole. It is impossible to extract this theory, to absolutely oppose it to other homeostatic mechanisms in the organism, to present it as something absolutely autonomous. Indeed, during the work under increased tension (in particular, in the emergency conditions), changes of the anterior lobe of hypophysis' functions gain important significance in human organism. At the same time, however significant the anterior lobe of hypophysis' role might be in providing conditions for the normal functioning of other endocrine glands, there is no reason to reject the principle of multiple procuring of functions and, therefore, not to admit the existence of other parahypophysial ways for

stimulation and regulation of endocrine glands' functions.

Apparently, the transhypophysial way of adaptation, being an integral part of the system of the unified theory of stress, fully explains *only the basic, irreversible, pathological changes*, taking place in human organism, working in conditions of extreme tension.

This process is analogues to the third stage in the famous triad of the General Adaptation Syndrome of Hans Selye.

During the first stage, *the alarm*, the initial level of steadiness and resistibility of organism somewhat descends at first, and then comes back to norm. Basically, at this stage organism is situated in the zone of normal functioning, mobilizing its defensive forces in order to adapt itself to the new life conditions, which have unexpectedly changed. But if organism is affected by the very violent and harmful agent, it can perish during the period of alarm.

But if the effect is moderate, then after the first stage comes an adaptation to the influence - the stage of *resistance*, e.g. a transition from the normal functioning of organism to a qualitatively another level - «*the adaptive norm*».

It is precisely at this stage, along with the transhypophysial way, the normal functioning of organism is provided by other parahypophysial ways of stimulation and regulation of endocrine glands' functions. It seems that it will be periodically necessary to control the state of «*adaptive intensity*» *of physical and psychotic forces of an operator*, whose organism is adjusted to various stressful influences in the process of its vital activity, to avoid an emergency and to prevent its transition to the stage of *exhaustion*, with its irreversible pathological changes.

Obviously the day soon will come when the role of a reliable indicator for evaluation of the state of physical and psychotic forces of an individual, working in the conditions of increased tension, is played by molecular-biological methods, which allow us to control the state of the «adaptive norm» of the genetic apparatus. The researches dedicated to reaching this goal are carried out in the scientific laboratories in Russia and abroad.

Presently the system approach to the analysis of nature and society's phenomena has gained wide propagation. This process is based to a large extent on practical demands of studying and solving of the global problems (the human health, ecology, exploration of the world oceans and the outer space and so on).

One of the first sciences to start using the systems approach was evolutional biology. From the middle of the 19th century onwards, the methods and data of almost every natural science have been finding their application within its field. As a result, Charles Darwin's theory of the natural selection and the modern synthetic theory of evolution were formed. Today, the continuing accumulation of new data and information will lead to the necessity of the renewal and additions to the theory of evolution and to the new synthesis.

Unfortunately, on the periphery of the evolutional doctrine still stays cybernetics - a science dedicated to general mechanisms of the processes of directions and connections in systems of any nature and complication. The subjects of cybernetics are the laws and mechanisms of the organization of systems. Since biogeocenosis, population and organism all represent the systems cybernetics could have become one of the connecting links in the multifaceted evolutional biology.

The evolution of cybernetics and the deep interest aroused by the sys-tem approach led to the creation of the *general theory of systems* as the integrated set of multitude of interconnected elements. The systems possess qualitatively different characteristics than do the elements which make up them (synergy). V.S.Kirpichnikov was one of the first who pointed out the part played by the interaction between the organs in the evolution. He demonstrated in 1940 that the interactions provoking adaptation are secured by the natural selection and not by the inheritance of acquired characters, as Jean Baptiste Lamarque thought.

This first attempt to understand the role of interactions in the systems of organism showed the possibility of removing the contradictions on the basis of the system approach.

The notion of a «formative factor» (an adaptive result, useful for a sys-tem's activity), coined by P.K.Anokhin, was a revolutionary

introduction to theory of systems. It has allowed them to develop a *theory of functional systems* (fig.1), which is still being successfully elaborated by P.K.Anokhin's followers and disciples (K.V.Sudakov et al).

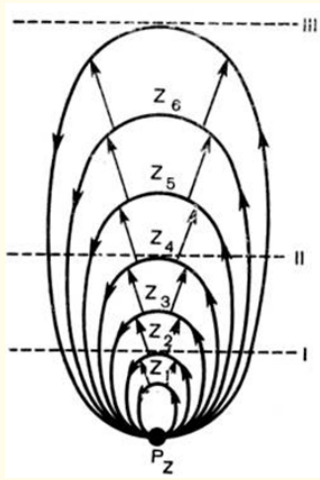

Figure 1: The fractal model of interaction functional systems according to P.K.Anokhin's.

In modern infography this type of models is called «Russian Doll» (the types of activities put one into another).

The functional systems of the body are the dynamic central-peripheral com-positions, united by *regulation*. Their components interact in order to secure useful adaptive results and to meet the various demands of separate systems and the organism as a whole.

In the functional system the assessment of parameters concerning the results achieved is constantly implemented by *backward connection* (*afferent*). P.K.Anokhin formulated and published this notion in the international academic press as long ago as in 1935. «The Father of Cybernetics» Norbert Wiener pointed to the existence of backward connection only in 1946.

Methods and notions used in cybernetics and its part, the theory of functional systems, are undoubtedly applicable for the interpretation of many evolutional phenomena. Organism and population (a unit of evolution) are systems of interconnected elements, oriented towards the achievement a useful adaptive effect.

In 1948, as a result of researches being carried out in P.K.Anokhin's laboratory, it was discovered that the external factors always exert an impact not on an isolated organ bun on a whole system. On account of that there was made a conclusion that it is always the functional systems which evolve and change under the influence of external factors, and morphologic trans-formations of external organs are only remote effects of those changes. At the same time P.K.Anokhin accentuated the role played in a natural selection by *heterochrony* (a non-simultaneous lay out and development of tissues and organs in embryogenesis). Intra-systemic heterochrony is a direct con-sequence of the natural selection.

Later P.K.Anokhin has formulated a principle of forward reflection of reality in functional systems, according to which as a result of repeating some phenomena in surrounding environment, functional systems of organisms intended for serving those phenomena gain a characteristic allowing them to get ready in response to the signal for an event that is only impending.

For anticipatory reflection of reality animals have the conditioned reflexes, needs and motivations. Only the influence of environment serves as a trigger for the anticipatory reflection of reality. Likely, emerging structures, functions or reactions serve as the defense against the other kinds of influence of environment. It's neither the cold which is a reason in autumn for casting leaves, the birds flying away, or shedding skin by birds and animals, nor a draught are the reason for plants in dry climate to cast off their leaves.

In many cases it is a change in the length of the day that serves as a signal for the changes to come, and that requires adaptations. In compliance with principle of a forward reflection of reality primary organisms have formed an ability to actively react against the changes in the outer world with a succession of anticipatory responses.

The biologist-evolutionist I.I.Schmalhausen studied problems of evolution as a regulated process, using widely the knowledge and methods of cybernetics. In 1939 and 1946 were published his books, dedicated to the emergence of regulative mechanisms in the evolutional process. I.I.Schmalhausen showed that selection, helping in creation of the regulative mechanisms of individual development, changes a character of development and creates the steady forms, constant with the permanent conditions of the environment and able to change along with its changes. Heterochrony, reducing dependency of development of systems on each other, increases the reliability of organism as a whole.

Almost simultaneously with P.K.Anokhin, I.I.Schmalhausen had made an attempt to analyze the interactivity of organisms with biogeocenoses on the basis of feedback and came to a conclusion that the result of development of organisms and the character of regulation responding on the impact of the environment were of a regulative character. The external stimuli in the shape of signals influence the organism, making it adjusting itself to the future changes of the environment. In essence, it was in consonance with the theory of forward reflection of reality. His last book - sadly unfinished - I.I.Schmalhausen dedicated to the place of cybernetics in the theory of evolution.

In his famous work «The reflexes of the brain», I.M.Sechenov postulated a well-known phrase: «All acts of conscious and unconscious life in its mode of origin are the reflexes». Let us, however, take note of another Sechenov's phrase: «The objective world existed and will exist, in relation to each individual, earlier than his mind; therefore, the primary factor in the development of the latter has always been and will be for us the external world with its objective connections and relationships» (Sechenov I.M., 1947). Namely the external world defines, according to Sechenov, the activity of human brain. Nevertheless, the question how the formation of functions of the brain, intellect and consciousness functions is performed under the influence of surrounding the subjects of reality still remains open.

The theory of functional systems, formulated by P.K.Anokhin (Anokhin, P.K., 1978, 1998), has offered a new perception of the brain functions organization. In contrast to traditional points of view, which were linking the brain function with the action of special stimuli that created reflected responding reactions of the body, the theory of functional systems reveals the inner mechanisms of the brain that determine goal-directed behavior and mental activity of humans and animals.

According to the theory of functional systems, the entire body is a harmonious interaction of a variety of functional systems of different levels: molecular, homeostatic, behavioral and population (Sudakov K.V., 2000). The central links of many functional systems include brain structures of different level. The interaction of different functional systems at the brain level is always based on the principle of domination, discovered by A.A.Ukhtomskiy (1925). At each given moment of time the brain activity is acquired by a functional system which is leading for preservation of life or adaptation of the body to the external environment. Other functional systems at this time either contribute to the activity of the dominant system function or just are paused. After satisfying the needs of the body, which has created the dominant functional system, another leading in social and biological significance functional sys-tem begins to dominate etc.

The dynamics of the functional systems formation in time follows the principle of *quantization of vital processes* (Sudakov K.V., 1997, fig.2). According to this principle, the uninterrupted continuum of vital processes in living organisms is divided into discrete segments - «*system quant*» from the need to its satisfaction. Each «system quant» includes the formation of the corresponding need, motivation and behavior aimed at satisfaction of this need, as well as continuous evaluation by the reverse afferentation of reached intermediate and final results satisfying this need. The brain architectonics providing «system quant» includes all system components defined by P.K.Anokhin: afferent synthesis, decision making, acceptor of the action's results and evaluation of parameters of reached results by the acceptor of the action's results on the base of incoming into the brain reverse afferentation.

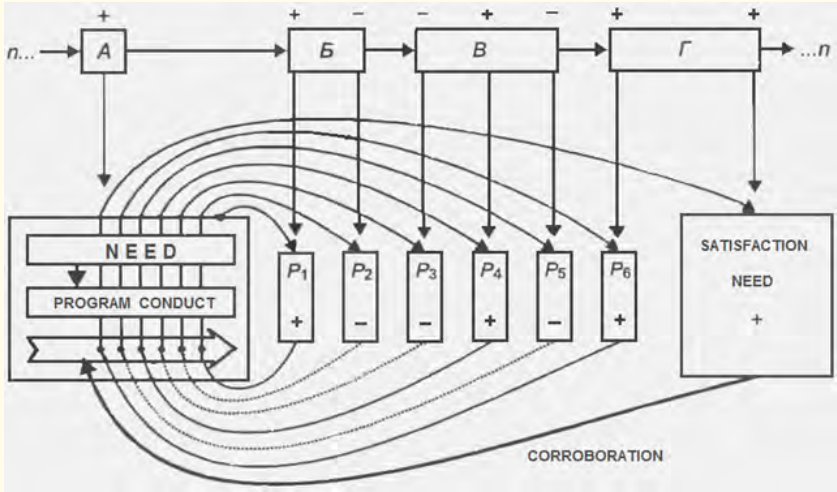

Figure 2: The «system quant» of behaviour n... → А → Б → В → Г ...n to K.V.Sudakov's, 1997.

n - succession events outward universe; P1 - P6 - stage results activities by satisfy the wants; «+» - results it was be conducive to attaiment final purpose and satisfy initail need; «-» - results it was be privent from satisfaction need.

The leading critical states of «system quant» of behavioral and mental activity of humans and animals are motivation and reinforcement, as an adaptive outcome that meets the underlying need of dominant motivation. Within the mechanisms of the functional systems domination in the brain the leading role belongs to biological and social motivations.

The *biological motivations*, as shown by our studies (Sudakov K.V., 1992), are built under the pacemaker principle. Pacemakers of biological motivations are localized in hypothalamic brain structures. Thanks to extensive morph functional connections with other brain structures and with cerebral cortex, the hypothalamic pacemaker neurons keep almost the entire brain depending on their condition.

Social motivations, initially formed on the basis of biological motivations, are also built under the pacemaker principle. Herewith, the pacemaker neurons that have determined the tonic activity of social motivations, are located, as it was defined (Leontyev A.N., 1976; Uryvayev Yu.V., 1978), in various, mostly in frontal regions of cerebral cortex, and integrate excitations of different sensory modalities, entering the corresponding projection zones of cerebral cortex. As our experiments (Sudakov K.V., 1996) and the experiments of other researchers (Gromova E.A., 1960) have shown, the dominant biological motivations of hunger, thirst and fear are clearly manifested in the reaction of EEG-activation generalized by structures of hypothalamus, thalamus, limbic brain structures and of cerebral cortex.

The ascending activating influences of motivationgenic centers on other structures of brain and cerebral cortex are «vital energy of each one of us» (Pavlov I.P., 1951).

The dominant motivations are closely linked to another leading systemic architectonics of behavioral acts - the acceptor of the action's result, which constituted the directing behavioral component (Sudakov K.V., 1998). Cortical pacemakers, created on the base of afferent synthesis processes, especially the pacemakers from frontal sections of cerebral hemispheres, have special properties. They, taking part in the formation of pre-launch integration, define, as Uryvayev Yu.V. Has shown (1978), the choice of dominant biological motivations. Together with this they have specific descen-ding inhibitory and activating effects on the pacemakers of biological motivations, located in hypothalamic area (Zilov V.G., 1965).

On the other hand, the pacemakers of frontal cortex determine the distant synchronization of EEG of temporal and occipital cortex

and perform configuration of certain analyzers to percept signaling stimuli, thereby determining the inter-signal interaction among analyzers (Uryvayev Yu.V., 1978).

Researches of our Institute's collaborators have shown that in the organization of motivational states, defined by the activity of a pacemaker, a significant role, together with neurotransmitters, belongs to the oligopeptides. Some of these endogenous oligopeptides strengthen motivational states, while others slow them down.

Stimulating food motivation effect belongs to oxytocin, beta-lipotropin, pentagastrin, whereas stimulating effect of defensive motivation belongs to bradykinin. Angiotensin-P, arginine-vasopressin, peptide that caused delta-sleep, substance P, beta-endorphin and other oligopeptides when introduced in lateral cerebral ventricles of rabbits were inhibiting defensive and food motivation (Sudakov K.V., 1988).

Vasopressin and oxytocin, as S.K. Sudakov demonstrated (1987), define the dominance of defensive motivation. In studies (Sudakov K.V., with co-authors, 1987) it is shown that introduction of oligopeptides in lateral ventricles of brain changes the modality of behavior when stimulating motivationgenic centers of hypothalamus. One might think that this reorganizes cortical-subcortical architectonic of dominant biological motivations. The presence of oligopeptides, such as substance P, peptide that caused delta-sleep, angio-tensin-P and other in hypothalamus determines the resistance of animals to emotional stress (Sudakov K.V., 1998) and the formation of alcohol motivation (Sudakov K.V., 1994).

A leading role in the organization of brain system functions belongs to the interaction of dominant motivations with the corresponding reinforcement, i.e., with the satisfaction of their underlying needs. The interaction of motivational and reinforcing excitations in neurons of the brain is based under holographic principle (Sudakov K.V., 1997). Nervous and humoral signaling from the need acts by analogy with the physical holography as supporting wave. Signaling from various parameters of reinforcement serves as objective wave. At the same time neurons of various brain sections included in the dominant motivational state, specifically reflect the appropriate need in the patterns of interimpulse intervals of their discharge activity. The percentage of such neurons involved in the organization of biological motivations, turned out to be higher in stem structures of the brain, which is decreasing toward cerebral cortex: the greater number of them is found in stem structures of reticular formation of thalamus and hypothalamus. The reinforcement transforms the pack-like irregular activity of these neurons into a regular one. It is characteristically that during numerous reinforcements, such as the development of conditioned reflexes, the regular activity in neurons, initially included in the dominant motivation, starts appearing in advance on the action of conditioned signals and even on the experiment's environment (Zhuravlev B.V., 1986).

The holographic principle of the dominant motivations construction and their interaction on neurons of the brain with the supporting excitations explains why, while preserving hypothalamic pacemakers, the damage of other brain structures doesn't not critically affect the behavior of animals, since the motivational excitation is spread to the conserved brain sections within this process. This opens up promising prospects for the compensation of damaged brain functions. It should be emphasized, however, that holographic principle of the brain's functions construction significantly differs from the physical holography.

Physical hologram - is the «frozen imprint of reality». Holograms of the brain are dynamic, they, depending on the parameters of reinforcing effects and different initial states of the body, are constantly changing. In living organisms it is advisable to speak of dynamic holography of the brain's functions. The interaction of dominant motivations with the relevant reinforcement on the brain structures includes emotional component. Its origin is related to the torsional mechanism of functional systems. When forming a need, i.e. the deviation of the result of one of the functional systems, under the influenced of signaling about the need, the negative emotion is created. By satisfying the need, when the elements of functional systems work toward returning the result to the optimal level for life, the positive emotion is created. Thus, emotions act as information bearing of states of adaptive results of the activity of various functional systems of the body performance, and in particular - of homeostatic level. The structures of the brain, where the interaction of motivational and reinforcing excitations occur, can be regarded as a kind of holographic informational display. On these structures the interferential interactions of oscillatory waves caused by motivational and reinforcing effects permanently take place (Sudakov K.V., 2000).

In each functional system the acceptor of the action's result acts as informational display. It is the structures of the acceptor of the action's result imprint the properties of the reinforcing effects parameters. The acceptor of the action's result represents the branched by brain structures architectonics in each functional system. His organization is related to the spread of formed by the original need of motivational excitations on executive pyramidal neurons of brain. Along with the spread of these excitations by pyramidal tract on effector organs, the copies of these commands by collaterals of pyramidal tract are addressed to different neurons from various brain areas, where this excitation, due to the closed chains, can be stored for a long time. Right these neurons receive excitation currents (reverse afferentation) under the influence of various parameters of reinforcing effects on the body. In addition, each reinforcement parameter is imprinted on a special group of intercalated neurons. Together, these intercalated neurons constitute a holistic «image» of reinforcements - the acceptor of the action's result mechanism - the imprints of reality. We believe these processes are the basis of dynamic stereotypes of a higher nervous activity, established by I.P.Pavlov. The enrichment of the acceptor of the action's result takes place during the whole life of the subject. In early stages of ontogenesis there are imprinted the signs of parents and of those environmental factors that meet the leading needs of newborns - the phenomenon of imprinting, discovered by K.Lorenz (Lorenz, 1965).

The basis of imprinting is made up of the expression mechanisms of early genes and, in particular, c-fos and c-jun (Anokhin K.V., 1997). Against the background of enhanced food motivation, when studying newborns with the help of manifested orienting-exploratory reaction of surrounding objects, they have had an expressed activation of c-fos gene in many brain structures. After achieving the result (satisfying the initial need) the expression of c-fos gene is reduced (Anokhin K.V. with co-authors., 2000).

When scanning the brain using positron emission tomography, it was revealed that the presence of thirst motivation in the subjects in structures of cingulate gyrus, hippocampus, thalamus, amygdala and cerebellum, there it was observed an intensified cerebral blood flow. After receiving the fluid, the circulation in these brain sections decreases (Denton D. et al., 1999). These processes seem to form the basis of the processes of recording reinforcement parameters on the structures of the acceptor of the action's result. The intimate nature of these processes is still far from being explored, which requires further scientific researches in this direction.

In each functional system the leading role in the formation of the acceptor of the action's result belongs to the reinforcement (Sudakov K.V., 1996). As shown by experiments (Sudakov S.K., 1987), molecular organization of the reinforcement includes the processes of protein synthesis. The introduction of inhibitors of protein synthesis does not suppress in untrained animals the orienting-exploratory and defensive reactions during electrical stimulation of «hunger» and «fear» centers respectively from lateral and ventromedial hypothalamus. However, if after electrical stimulation of these centers, animals are trained to achieve a useful adaptive result, i.e. to obtain food during the stimulation of «hunger center» from lateral hypothalamus or to avoid the room in which their «fear center» from ventromedial hypothalamus has been stimulated, the same blockers of protein synthesis during their introduction into lateral ventricles of the brain begin to effectively suppress these productive reaction. These experiments show that under the influence of reinforcements, the molecular engrams of reinforcement blocked by protein synthesis inhibitors are formed in brain structures.

In experiments conducted by us it was revealed that food motivation in trained rabbits blocked by the protein synthesis inhibitor - cycloheximide, became restored after introduction into lateral cerebral ventricles of penta-gastrin of animals, a defensive reaction became restored after introduction of bradykinin, and reaction of self-stimulation - when introducing AKTG4-10 (Sudakov K.V.,1995). Special experiments (Sudakov S.K., 1987) have shown that these processes of creating memory engrams occur on structures of the acceptor of the action's result.

Cycloheximide, when microionoforethically used, was blocking in rabbits the reactions of intercalary neurons of sensorimotor cortex to antidromic stimulation of pyramidal tract.

The introduction of antigastrin immunoglobulins in animal was also blocking food reactions in rabbits when stimulating «food center» of lateral hypothalamus (Sudakov S.K., 1986). All this shows that special protein molecules of pentagastrin are involved in the realization process of dominant motivation into appropriate behavior.

In the extraction of molecular engrams of the acceptor of the action's result created by reinforcement the leading role belongs to dominant motivations. When relevant need appears, the dominant motivations retrieve in advance previously generated images of reinforcements. Namely this mechanism directs the subjects toward the goal - the satisfaction of the original dominant need. The dominant motivation sets the brain to a more keen perception of reality and creates a kind of «canvas» of excited neurons in brain, where supporting excitations «write» in each case specific engrams, which, when further relevant need appears, are retrieved by dominant motivation. During the blockage of the reinforcement's molecular engrams the motivational excitation, extending to the brain structures, is not able to gene-rate appropriate behavior.

As experiments have shown (Kotov A.V. and Tolpygo S.M., 1978), the activation of engrams of the reinforcement is also observed under the influence of previously established conditioned stimuli. In the course of individual live the enrichment of dynamic stereotypes occurs - the correspon-ding acceptors of the action's result.

The basis for the construction of acceptors of the action's result are the emotional states. They create a subjective image of internal needs and of their satisfaction. They are those who define emotional consciousness, built on the basis of continuous evaluation of needs and their satisfaction.

The imprints of reality on structures of the acceptors of the action's result are dynamic and depend on the parameters of the reinforcement and the ways of satisfying the needs. The imprints of reality are wound up like the «ball of wool» on the earlier created stereotypes. Thus, the present reality is inextricably linked with the experience of the past. You can completely agree with V. Goethe, who wrote: «Everything that happens to us leaves one or the other trace in our life. Everything is involved in creating us as we are».

The processes of continuous formation on the brain structures of dynamic stereotypes and the extraction of «imprints of reality» out of memory determine, finally, the intellect of one individual. On the other hand, the information processes that take place in the brain structures, form the subjective experience of the individual.

The architectonics of intellect includes all stages of systemic organization of mental activity: the dominant motivation, situational afferentation, memory, decision making, prediction of required results (the acceptors of the action's result), efferent synthesis, and finally - the evaluation of reached parameters of the reinforcement with the help of the acceptors of the action's result. However, the key role herein is played by the imprinting of results parameters that satisfy initial needs of the body on structures of the acceptors of the action's result activated by dominant motivations.

Imprinting and reproduction by dominant motivation of imprints of reality - the memory engrams in structures of the acceptors of the action's result - is based on the informational equivalents of reality.

In 1969 P.K.Anokhin wrote: «... In the theory of information, there exists an idea of accurate transmission of information about some object regardless of encoding. I would call these stages of information transmission the informational equivalent of the object. It means that the process of information, whatever link it is caught in, in principle contains everything that makes up the most characteristic features of the original object, but these symptoms can be represented in different codes» (Anokhin P.K., 1969).

Informational basis of intellect is made up of emotional consciousness (Raykov V.L., 1998) - a continuous evaluation of various needs of the body and their satisfaction with the help of specific emotional experiences.

In the formation process of subjective images of objective reality there can be distinguish endogenous and exogenous stereotypes. Endogenous stereotypes are based on emotional feelings during creation and satisfaction of variety of internal (metabolic) body's needs. Exogenous stereotypes are created under the influence of environmental factors, determining the sensory consciousness.

In addition, the general architectonics of «imprints of reality», along with sensory «imprints», includes motor stereotypes associated with stereotyped movements that determine the satisfaction of various needs of the body (Asmayan N.V. and Bogomolova E.M., 1976). Everybody knows how stable the learned actions are. They appear often and idle, when for various reasons the previously familiar

situation changes. This element of intellect can be regarded as «motor consciousness».

Created on endogenous and exogenous basis, the dynamic stereotypes, characterized by specific changes in convergent and chemical properties of neurons in the brain, act as holographic screens of the brain, a kind of «filter» of external influences. In humans, unlike other animals, the subjective perception of reality through dynamic stereotypes is defined not only by emotional feelings, but also by verbal, linguistic knowledge. This is how the first and the second signal systems proposed by I.P.Pavlov appear.

Subjective evaluation based on the experience of internal states of surrounding reality determines, in the end, emotional and verbal consciousness of a man. Consciousness appears as a process of comparing the information coming into the brain from internal and external environment to the previously accumulated information experience - «imprints of reality».

«... The specific mechanisms of producing the subjective in conscious-ness, P.K. Anokhin wrote in 1969, are not describable yet, however their exact informational link with the initial parameters of objective world cannot be questioned».

The ideas about informational equivalents of reality allow starting in reality exploring the inner ideal side - «the human consciousness», determining norms in live and artificial.

When analyzing the penetration of ideas of cybernetics into the doctrine of evolution, it is impossible not to remember one of the greatest scholars of cybernetics A.A.Lyapunov. Considering biology from the positions of cybernetics, he emphasized that the most complicated range of problems in evolutional theory was an evolution of directing systems of living nature.

A.A.Lyapunov has formulated a hypothesis that the emergence of new structural elements on some kind of level of organism leads to the formation of the new levels of its directing systems. Meanwhile the formation of the highest level of directing can emerge most easily during the periods of an unstable mode.

Their successor in the development of evolutional concepts from the positions of cybernetics V.F.Turchin considered human biological evolution from the cybernetics positions as early as in 1977. He assumed that in the evolutional process the transition from the lowest levels of a system hierarchy to the highest was taking place via meta-system passages (*theory of metasystem passages*). This approach can be viewed as a continuation of A.A.Lyapunov's hypothesis about a process of formation of the new levels in the directing of organism. This is an example of meta-system approach ac-cording to V.F.Turchin: directing of condition → movement; directing of movement → irritability (a simple reflex); directing of irritability → (a complicated) reflex; directing of reflexes → associations (conditioned reflex); directing of associations → human mentality (mental activity); directing of mental activity → culture.

One of the modern manifestations of the last stage of meta-system transition, according to V.F.Turchin (directing mental activity to culture), is a scientific-practical area of activities - *infography*. It can be considered as a culture of directing mental activity.

Another application of cybernetics in the analysis of evolutional processes is *modeling*. The main factors, defining specific character of the modeling of evolution are: ● clearly expressed variability of biological objects, practically excluding precise prognosis of the evolution of population systems; ● the impossibility, as a rule, of experimental verification of a theoretical model.

Until now, modeling in evolutional biology and population ecology has been considered not as a scientific method, but rather as an art and the quality of models being created has been evaluated not in compliance with scientific criteria, but according to cultural considerations or even vogue.

Unfortunately, innovative approaches in the field of modeling of evolutionnary processes in biology spring up much rarely than in technology, and quite often do not step any further than borrowing the analytical resources from the other areas of knowledge.

Having considered all mentioned above, the authors suggest to analyze the interconnections of the *norm* in artificial (art and natural, technological) systems and the *adaptive norm* in natural (living) systems. The analysis of the problem of «norm» is done on the basis

of theoretical achievements and usage of practical data from biology, medicine, engineering and social psychology and anthropotechnology.

The task of our research is not the establishment or description of the facts. This is the goal of experimental sciences. The facts will be considered on the level of explanations, at the stage of their inclusion into a theoretical system. In this book the predominant attention is concentrated on the determination of the biological and anthropotechnological premises and foundations of norm.

Many problems are of a disputable character. The author is distant from the thought that the statements, advanced by them are impeccable. But they consider it necessary to draw attention to them in order to promote the success of the further, more profound, studies.

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