DOI: 10.12731/2218-7405-2013-8-20

SYSTEM ANALYSIS OF HUMAN EVOLUTION

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Goal. The goal is to give grounding to possible outcomes of present-day global crisis of civilization and to provide a set of recommendations to the population on how to adapt to the crisis.

Method. System approach, which views a system as a functional entity, whose function is determined by the function of an entity placed at a higher level of observation. The approach analyzes the relationship between functional ability of human as a system and functional demands of the environment to the human as a system of a higher hierarchy level.

Results. The article shows that current global civilization crisis is similar to the Neolithic Revolution, which replaced non-productive economic activity with productive activity that led to the emergence of a new human type of human, who possessed new functional abilities. There is an assumption that current crisis leads to emergence of a new kind of economic activity and a new type of human.

Scope of Application of Results. The article provides recommendations on how to change functional abilities of humans to ensure their better adaptation to the crisis. The results can be applied in developing concepts and models of sustainable development of civilization.

Keywords: system analysis; system approach; human as a system; human evolution; extraneous determinant of the system; internal determinant of the system.

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Modern Research of Social Problems, №8(28), 2013
 www.sisp.nkras.ru

СИСТЕМНЫЙ АНАЛИЗ ЭВОЛЮЦИИ ЧЕЛОВЕКА

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Цель. Обоснование вероятных последствий современного глобального кризиса цивилизации. Выработка рекомендаций по адаптации населения к этому кризису.

Метод. Системный подход, рассматривающий систему как функциональный объект, функция которого обусловлена функцией объекта более высокого яруса. С помощью данного подхода анализируется связь между функциональной способностью человека, как системы, и функциональным запросом к человеку окружающей среды, как системы более высокого яруса.

Результаты. Показано, что современный глобальный цивилизационный кризис аналогичен неолитической революции, в ходе которой хозяйственная непроизводящая деятельность была заменена производящей. Показано также, что это повлекло за собой формирование нового вида человека с новыми функциональными способностями. Обосновано предположение, что современный кризис ведет к появлению нового вида хозяйственной деятельности и нового вида человека.

Область применения результатов. Сформулированы рекомендации по изменению функциональной способности людей в целях их адаптации к кризису. Результаты могут быть применены при разработке концепций и моделей устойчивого развития цивилизации.

Ключевые слова: системный анализ; системный подход; человек как система; эволюция человека; внешняя детерминанта системы; внутренняя детерминанта системы.

Introduction

It is common knowledge that traditional way of the development of civilization can lead to a global catastrophe. In 1992 the United Nations Conference on Environment and Development admitted that development pattern of modern civilization is an *unsustainable development model.* The highest body of the world community appealed to governments and citizens of all countries and recommended to adopt *sustainable development* model, which has to ensure, firstly, survival and sustainable development of the humanity, secondly, protection of the biosphere, i.e. be *biosphere-centered*.

The grounding of the fact was obtained as a result of simulation of global development (*global modeling* [see 3]). 'Mathematical models show that the power of human impact on nature is comparable to the power of natural forces, which puts the world under the threat of a global crisis (demographic, ecological, energy, crisis of mineral resources, etc). Thus, it has become vital to unite the efforts of the humanity and the scientific community to solve global problems. To ensure adoption of a new model of development it is necessary to change consciousness and interests of people, switch to new paradigms and goals, refuse certain demands, which till recently were considered natural.' [12, p. 8].

Authors of sustainable development concept see the solution to these problems in shifting the focus of global development from material and energy-centered paradigms to informational aspects. This shift can result in the creation of an *information society,* which is the first stage of the *noosphere* [12]. Transition from energy-centered material model to information model of the society is supposed to foster sustainable development, where the economy of the future will be based on knowledge and scientific information [13]. One of the first signs of appearance and development of information society and the noosphere is the emergence of 'system research', a scientific branch used for 'dialectic processing' of new scientific knowledge in every field, a certain means to 'structure' the noosphere [15, p. 191].

Let us look at the possible application of the latest achievements of system

research to give grounding to possible consequence of the abovementioned global crisis, including anthropological.

Basic Notions of the System Approach

Let us define the main concepts of the system approach and use them to give a clear definition of what 'evolution' is.

'Noospheric' system approach (or *functional systemology*) views a *system* not as a multitude, but a *functional entity whose function is determined by the function of an entity placed at a higher level of observation (supersystem)* [8]. The *function of the system* is the role, the mission of the system within the supersystem, which is revealed in *functional ties* of the system. Thus, the function of the supersystem determines the function of the system, the function of the system determines the function of subsystems, etc. So, the system is connected with the supersystem by *the relations, which sustain functional ability of the whole.* The phenomenon when the functions of the supersystem determine the functions of the system is called *extraneous determinant of the system* (or *functional demands of the supersystem*). In fact, the general revealed function of the system (its functioning) is called *inner determinant of the system*. It determines the functions of subsystems (individual functions of the system) and their interconnections. *Current inner determinant* is a characteristic of a current functional ability of the system achieved at the moment. *Maximum inner determinant* is a characteristic of (maximum) functional ability of the system, needed for the supersystem, which corresponds to the extraneous determinant. Functional ability of the system has to be gained as the result of adaptation of the system to the demands of the supersystem.

Thus, the supersystem is obviously 'interested' in the system which complies with its demands, i.e. the one, which can support it. The supersystem is not 'interested' in a system, which does not comply with its demands, and, consequently, it will not 'put any effort' to either give the right direction to the system or discard it

(replace it), sustaining its own functions and stability [8]. Thus, a system is stable as long as it complies with the demands of the supersystem as the latter needs it.

Bringing the system's inner determinant closer to its extraneous determinant (i.e. functional demand of the supersystem) is *adaptation of the system to the demand of the supersystem.* The existing relation between the functional demands of the supersystem and the abilities of the system is the criterion, which shows the extent to which a system is adapted. A perfect or well-adapted system is the one, whose inner determinant is as close to extraneous determinant as possible. The approach views adaptation of the system to the changing demand of the supersystem as the *evolution of the system.*

As we can see from this unfortunately brief study of basic notions of functional systemology, the suggested system approach gives clear and concise definition of 'evolution'. This system notion of evolution enables to give definition to the mechanism of evolution of the system called '**Human'**. This mechanism can be revealed by detecting extraneous and inner determinants of the system and their interrelation.

Analysis of Inner Determinant of the System 'Human'.

As far as inner determinant in concerned, we can easily see functional ability of the human if we look at subsystems, a so-called components of *sensomotor activity*, which are part of the system **Human.** Sensomotor control forms a cybernetic (looped via external environment) pattern of the system functioning. Such kind of system is controlled by means of interaction of three modules: *sensor recognition, decision taking module* and *motor activity* [5]. In our case we view the three modules at several levels, corresponding to the levels of reflection the human has (sensor recognition) and mental activity (decision taking module). According to the theory of reflection and psychology of thinking [11], we need to consider four levels of sensormotor activity. Thus, according to the approach, the system **Human** is comprised of four interacting subsystems, whose functioning sustains the functioning

of human as a whole. Let us take a closer look at these subsystems, each of them consisting of the abovementioned modules, and their functions, using the paper [7] (see picture).

Subsystem 1 provides reception of signals from external and internal environment, physical and physiological reflex responses (heartbeat, breathing, transpiration, vessel constriction, vascular distention, myosis, mydriasis, muscle contraction, work of elimination system, etc.)

1.1. Sensor detection of signals from external and internal environment in the form of separate sensations (visual, audial, osmetic, tactile, tate, etc.)

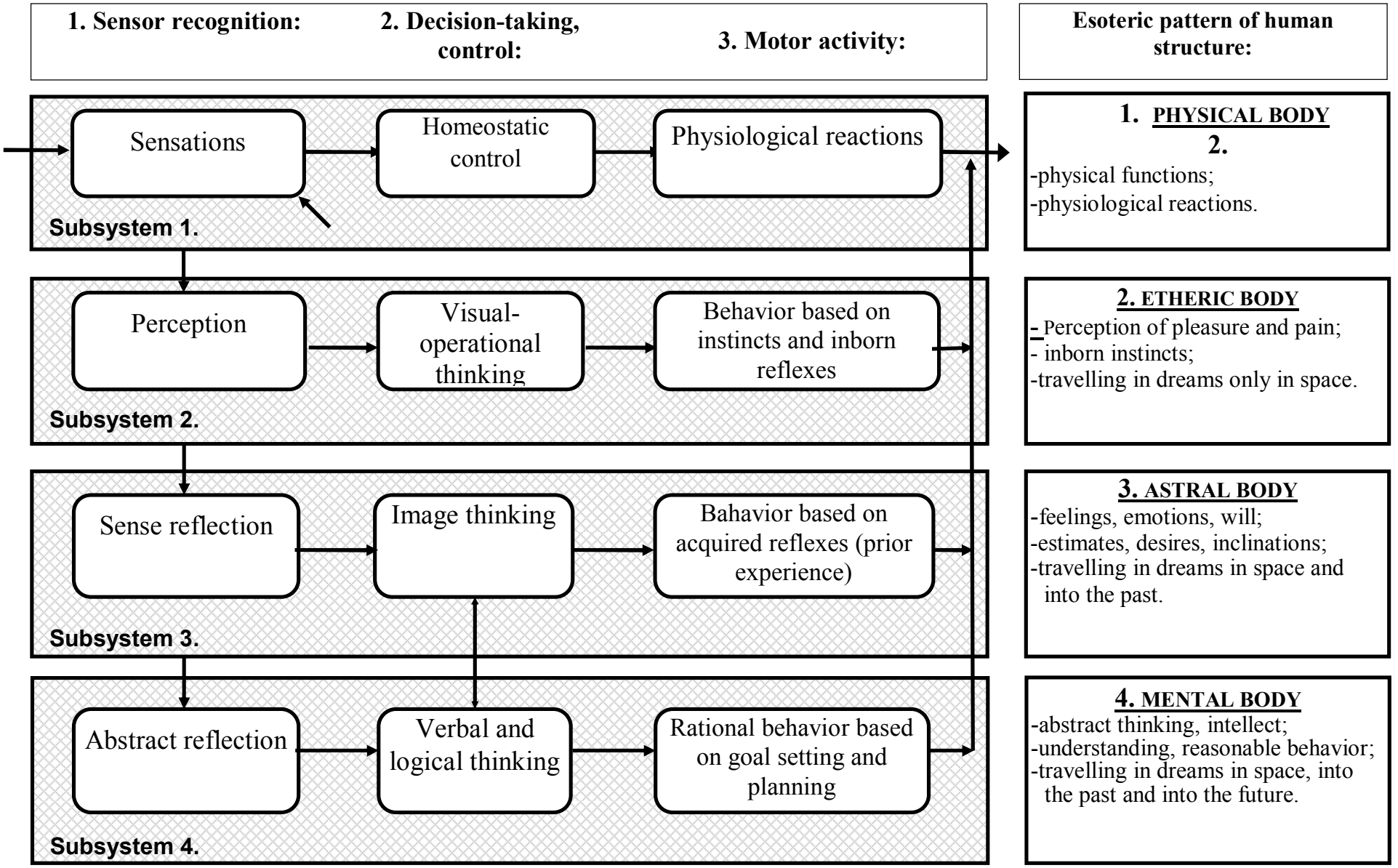
1.2. Homeostatic control, i.e. controlling by means of sustaining constant characteristics of inner environment of the subsystem.

1.3. Motor activity in the form of physiological reactions.

Subsystem 2 ensures primary semantic processing of sensor information; perception of pleasure or pain; creation of images of surrounding phenomena; work of inborn reflexes (sucking reflex, food reflex, breeding reflex, etc.)

2.1. Detecting different types of information, which comes from Subsystem 1 by creating preliminary integral concise image of a current situation.

2.2. Formulating and taking decisions in a current situation by using visual-operational thinking, which is based on physical transformation of a situation and testing properties of objects.



Pic. Levels of Human Sensormotor Activity

2.3. Acting in a current situation in the form of instinctive behavior based on inborn reflexes.

Subsystem 3 is responsible for secondary semantic processing of sensor information; emotions, desires, aspirations, inclinations, feelings, imagination, volitional impulses and estimates; creating and storing generalized images of surrounding phenomena; behavior based on acquired reflexes (prior experience).

3.1. Recognition at sense reflection level 'based on associations or similarity' between information, incoming from Subsystem 2 by means of preliminary creation of generalized images, which resemble reflected phenomena of the environment. This is done by means of overlapping current images and memorizing repeated details with the help of *'summation mechanism'*.

3.2. Formulating and taking decisions at image thinking level by creating a visual model of the situation and imagining how it would change depending on the changes of various perceived or reflected characteristics of a phenomenon.

3.3. Activity in the form of behavior based on acquired reflexes (prior experience).

Subsystem 4 sustains self-consciousness, intellectual performance, understanding, rational behavior, synthesis of ideas and creating hypotheses.

4.1. Recognizing information at an abstract level of 'recognition based on associations and similarity' coming in from Subsystem 3 by means of creating preliminary images of semiotic nature (first of all, words of a natural language - notions), which reflect certain characteristics of phenomena that are not necessarily perceived by senses. This is done with the help of creating hypotheses and testing them against existing properties of phenomena with the help of a so-called '*mechanism* of *active search'*.

4.2. Working out and taking decisions at verbal and logical thinking level performed with the help of notions, logical constructions and language means, and with the help of generalization and abstraction.

4.3. Conscious and rational behavior based on goal-setting, planning and forecasting any changes or developments.

The presented system shows that every next subsystem, which represents a new quality level, cannot function without information created by the previous subsystem. Even more, every next subsystem is actually an evolutionary superstructure above the previous one. For example, goal-setting and planning in Subsystem 4 is done only because of the motifs that exist on the level of Subsystem 3. These in their turn result from the ability to perceive sense pleasure and pain on the level of Subsystem 2. Recognition of pleasure and pain is finally based on the ability to constantly sustain characteristics of inner environment (self-preservation) of Subsystem 1.

The results of study of the subsystems and their functions within the system **Human** suggest that presently the main functional ability of the human species is in rational behavior, which is based on abstract reflection, verbal and logical thinking, goal-setting and planning.

The conclusion complies with the modern concept of human and his nature. Such characteristic features of human society (anthroposphere) as rationality, intelligence and transformation of their products - science and technology - into geological factor of the evolution of the planet [2] undoubtedly says for this conclusion. Moreover, rational consciousness, intellect, verbal and logical thinking skills are very often viewed as a characteristic feature of human as a species [6]. Besides the compliance of the suggested model of sensomotor activity of human with present-day scientific concepts it complies with the ideas of great thinkers of the past expressed in a so-called esoteric psychology [9,14].

Analysis of Changes in Extraneous Determinant of the System HUMAN

The change of functional ability of the system is the change of its inner determinant. The change of inner determinant may occur either upon constant

functional demand on the side of the supersystem (adaptation) or in case of change in extraneous determinant of the system (evolution). Therefore, in a general case before analyzing change of functional ability of the system it is necessary to analyse extraneous determinant of the system, i.e. functional demand of the supersystem.

Function of one of the levels was viewed as a current inner determinant of the system when the pattern of sensormotor activity was being created. Thus, to compare and contrast the changes in inner and extraneous determinants we need to follow in what way the change of living conditions of human ancestors is connected with their sensormotor activity. For this purpose we need to make use of the results of anthropological, paleontological and archeological research, the most significant of which in our opinion is the data about the end of the Paleolithic age (Old Stone Age) and the beginning of the Neolithic Age (New Stone Age). The period of transition from one stage to another is of particular interest as it is connected with the appearance of present-day human and is 'one of the most critical and magnificent periods of the past – the period of emergence of civilization' [10, p. 164]. Thus, the analysis of strategic factors of the period is of particular significance to shed light on the evolution of the system **Human**.

This period is of primary interest from the point of view of a so-called 'neolithic metamorphosis' (Pierre de Chardin) or 'neolithic revolution' (G. Childe), which was marked with *productive* economic activity replacing *non-productive* activity. Replacing of foraging with production activity typical for that period of transition from paleolith to neolith is common knowledge and is widely used in the development of the concept of survival and sustainable development of the humanity [13]. Let us take a closer look at some of these facts in order to highlight the most important aspects of this period and ecological crisis that took place at that time in particular.

Firstly, let us look at the classical and poetic description of the process by P. de Chardin: 'First of all it was a never-ending reproduction progress. As the result of the increase in the number of people there was less free territory. The groups started

colliding, which prevented them from relocating too far and there arose the issue of getting the best possible results from the property, which was getting more and more limited in space. We can suppose that it was this necessity that pressed people to start preserving and reproducing on site things they used to look for or pursuit far away before. Cattle breeding and cultivating land replaced foraging and hunting. A shepherd and a farmer. This crucial shift gave rise to all the rest'. [10, p. 165].

Secondly, we can look at more up-to-date and specific data from the history of economic and cultural development of humankind. 'Extinction of large animals and further growth in population by the end of the Upper Paleolithic period resulted in a grave crisis of the hunting sector, which embraced vast territories of warm moderate climatic zones. In some regions crisis was a catastrophic reality… In the areas where the crisis of the hunting sector was especially severe and where there was no opportunity to migrate or develop new territories, hunters and foragers had to make use of available natural resources and perfect their technology. The progress in perfecting tools and life-supporting systems fostered development of productive activities. …Using unique archeological material archeologists managed to follow many stages of adoption of crop farming in Mesoamerica. 12 – 10 thousands of years ago during the grave crisis even gnawing animals served as hunting prey. The population intensified foraging edible plants, which helped them to develop their farming skills. … Attempts of 'harvesters' to compensate for the ceasing natural thickets of edible plants by creating plantations was crucial in those times. This thesis was proved by experiment with materials of a cave settlement in the valley of the Oaxaca river… There is also evidence of the process of adoption of cattle breeding and plant growing in archeological sites in South-Western Iran in the valley of the Deh Luran river …' [1, p. 76-78].

The acquired data enables us to describe the process of transition from the Paleolith Age to the Neolith Age in terms of determinant analysis. From system point of view the process can be seen as the change in certain aspects of extraneous determinant of the system **Human,** which revealed itself in the change of ways and

conditions of life activities of human ancestors of that time.

Analysis of Inner Determinant of the System Human

Change in inner determinant of the system always leads to the change of its maximum inner determinant, which in its turn leads to consequent change in its current inner determinant. Let us look at this process in connection with the change of extraneous determinant of the system **Human** in the course of transition from the Paleolith Age to the Neolith Age (Neolithic revolution).

Comparing living conditions before and after the Neolithic revolution we can see that before the Neolithic revolution in his non-productive economic activity the human had mostly to rely on his prior experience, while after the revolution productive economic activity made him apply planning and goal-setting in the first place. Thus, we can state that in the course of transition from Paleolith to Neolith and subsequent Neolithic revolution extraneous determinant of the system Human, which had previously determined the development of the third level of sensomotor activity, changed and required the development of the fourth level.

To be able to analyze the changes of current inner determinant of the system Human during that period we need to follow the changes of characteristics and peculiarities of sensomotor activity of human ancestors. Anthropological and paleontological literature has enough evidence of it. In our opinion, the most important data is that related to substitution of the paleanthropus, an ancient human of the Neanderthal type with the Neoanthropus, i.e. a modern type human, a so-called Cro-Magnon man. You can see the results of comparison of the characteristics of sensormotor activity of humans of both types as of [1, 4 - 6] in Table 1.

Table 1

Neanderthal Man	***CRO-MAGNON MAN***
Figurative representation of information in the memory, lack of its logical or notional processing. Intellectual ability is at its primary stage.	Archaic way of thinking has preconditions of rational perception of reality. Beginnings of intellectual ability.
Verbal ability is present, however poorly developed. Could not pronounce many sounds of modern languages.	Well-developed verbal ability. Could easily pronounce all the sounds of modern languages.
No evidence of any signs or symbols on the walls of the caves or tools.	Used signs and symbols to denote phenomena. Decorated tools with ornaments. Drawings on the walls of the caves.
Little variation in the basic types of tools.	Hundreds of types of tools.
Primitive techniques of making tools, did not require any qualification, any adult could use them.	Tool-making techniques rapidly became highly efficient; good qualifications, skills and a lot of time were needed to make them.
No signs of functional specialization.	Activity gains the characteristics of a profession.

Thus, we can conclude, that Neanderthal man, who mostly did hunting and foraging used mostly three levels of sensomotor activity (the third level domineering), while Cro-Magnon man who adopted cattle breeding and plant growing has started using the fourth level.

We can see the results of the change of inner and extraneous determinants of the system **Human** in the process of transition from Neanderthal man to Cro-Magnon man in Table 2.

Table 2

STAGES OF EVOLUTION	**TYPE OF HUMAN**	**Characteristics of Life Activities (extraneous determinant)**	**Characteristics of Sensomotor Activity (inner determinant)**
The Paleolith Age	Neanderthal Man (paleoanthropus)	Non-productive activity mostly based on prior experience (hunting and foraging). No constant division of labour.	Sense reflection prevails. Archaic thinking based on classifying according to perceived characteristics. Interpretation of new phenomena is based on comparison with familiar phenomena. Activity based on acquired reflex and past experience prevails. Use of symbols (not signs) prevails, poor verbal ability.
НЕОЛИТ The Neolith Age	Cro-Magnon Man	Productive activity based on planning (farming and	Development of abstract thinking ability. Well-developed

		cattle breeding). Development of labour division.	archaic thinking with rational elements. Development of basic notions and logical thinking ability based on simple inductive and deductive inference. Development of activity based on planning and goal-setting. Use of symbols and signs to denote phenomena. Good verbal ability.

The table shows interconnection of these processes. In the Upper Paleolithic stage extraneous determinant of the Neanderthal man was that of non-productive activity. It preconditioned inner determinant in the form of relatively well-developed third level of sensomotor activity, which should probably be viewed both as current and as maximum. At the beginning of the Neolithic epoch extraneous determinant of humans changed and became typical of productive activity. This extraneous determinant preconditioned emergence of inner determinant in the form of developing fourth level of sensomotor activity, which was maximum for the Cro-Magnon Man.

Current inner determinant of a Cro-Magnon Man was a transition phase from dominating third level to dominating fourth level. However, this current inner determinant of the Cro-Magnon Man was more in conformity with extraneous determinant of the period rather than maximum inner determinant of the Neanderthal Man, which preconditioned departure of the latter.

When life conditions get more complicated during the global crisis, this activates the next level of sensomotor activity of the system **Human** and thus, we can suppose that present-day problems of civilization and anthropological crisis will also lead to the change in sensomotor activity of the system.

Let us look at possible tendency of this change.

During the study of the levels of sensomotor activity of the system **Human,** which can be viewed as its subsystems, there is no evidence of any other types of representation or thinking, etc. other than the four provided in pic.1. What does the change in sensormotor activity involve then?

Literature describes the problem as follows. 'The greater part of our actions is determined by involuntary impulses. All our life is made up of minor things, which constantly influence us and which we are guided by. Our 'ego' is constantly changing, like in a kaleidoscope. Any outside event, which impresses us, any spontaneous emotion becomes a king for a day, starts managing and governing us and later is overthrown by something else. However, the consciousness does not attempt to dissolve the illusions of the kaleidoscope, it does not realize that the power, which takes decisions and acts, is not the consciousness itself. So, it 'signs' all its decisions and speaks of all the numerous moments in life, where various powers are involved as 'this is me, and that is me, too'' [14]. In connection with the development and personal growth it says 'actual growth is in harmonious development of mind, senses and will'. Besides, it is important that 'the issue of reaching the unity is a core issue of personal growth as until a person reaches it they can have no 'ego' and is deprived of willpower.' [14].

Therefore, we can suppose that the abovementioned change in sensomotor activity is none other than evolvement of functional unity of the system **Human,** which appears when all the four levels of sensomotor activity come into one unity.

You can see results of comparison of supposed change in extraneous determinant of the system **Human** and supposed change of inner determinant of the system, which results from present-day global problems of civilization in Table 3.

Table 3

STAGES OF EVOLUTION	TYPE OF HUMAN	Characteristics of Life Activities (extraneous determinant)	Characteristics of Sensomotor Activity (inner determinant)
MODERN	Homo sapiens	Models of 'unsustainable development' (industrial and agricultural; capitalist and socialist). Destructive economic activity.	Abstract reflection prevails. Well-developed verbal, logical and rational thinking skills. Activity based on planning and goal-setting prevails. Results depend on classifying according to various paradigmatic principles (paradigms, ideology, etc.) and adherence to past experience

			(traditions). Natural and synthetic languages. No coordination of levels of sensomotor activity.
NEOSPHERIC	Homo ...? (harmonious, holistic)	Models of 'sustainable development'. Non-destructive economic activity.	Harmonious interaction between levels of sensomotor activity. Holistic reflection and thinking, taking into consideration the results of work at all the levels. No adherence to past experience or results of rationalization or classifying.

Presently, well-developed skills of abstract reflection, verbal and logical thinking, and motor activity based on goal-setting and planning is the functional ability of human (current inner determinant). However, present-day human has no coordination, harmony or unity of levels of sensomotor activity, which constitute his subsystems.

In the past this inner determinant conformed to extraneous determinant (functional demand of the supersystem), which required organization and introduction of productive economic activity. In modern conditions extraneous determinant of the system **Human** has changed and constitutes a functional demand to overcome global crisis and ensure the adoption of sustainable development model (*non-destructive economic activity*).

Conclusion

Having conducted the analysis of the previous stage of the evolution of system **Human** we can suppose, that present-day recessionary transition period of the development of civilization is characteristic of a new evolutionary shift - homo sapiens is being replaced by *'noospheric human'*, that would comply with the change that has occurred in extraneous determinant. Taking into consideration temporal compression and acceleration of historic process, which is the case, we can expect a speedy change – within two or three decades. This supports forecasts of various researchers, who predict catastrophes in the nearest future, which according to their

studies, are aimed at fostering replacement of the old and obsolete type of human with a new more progressive one and literally clearing out living space for him. Apparently, the representatives of *homo sapiens* able to holistically use all the levels of sensomotor activity, will serve as raw material for the new system (‘**noospheric human’**).

Holistic (system, harmonious) algorithm of functioning of the system **Human** presupposes considering the following criteria in any situation (see pic.1):

- conditions of outside and inner environment (Subsystem 1);
- current state of things (Subsystem 2);
- past experience (Subsystem 3);
- functional goals with consideration of future development and changes in the current situation (Subsystem 4).

Analysis shows that potentially the Human is able to function holistically integrating all the levels of sensomotor activity and to avoid prevalence of any of them over others. Great Spiritual Masters have proved that it is possible by their example [9]. Nowadays, this opportunity is turning into necessity; it is becoming vital for his very survival in the oncoming global crisis.

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