The Big Bang was the result of the inevitable laws of physics and did not need God to spark the creation of the Universe.

Stephen Hawking

G. Zaltsman

Scientific Laws of the Progressive Evolution of our World[1]

Hierarchy of Scientific Abstraction of Component Objects

This article presents an attempt to generalize the mechanisms of progressive evolution of the world through consecutive stages of its scientific description – direct, disciplinary, interdisciplinary and integrated[2]. This approach describes the models of the progressive evolution of the discrete matter out of the energy field and discrete information out of the images derived from the material environment. The article reveals their logic, works out formulas and calculus and gives their scientific interpretation. Natural process of brain development projects the prototype of artificial intelligence. Objects that have no acknowledged scientific definitions are interpreted from the author's point of view.

Keywords: progressive evolution, systemic organization, natural information, self-consciousness of the individual, self-development of the world, self-reproduction of the organic world, self-regulation of animals, self-consciousness of man, artificial intelligence.

Introduction: Disciplinary scientific objects of progressive evolution

The contemporary idea of progressive evolution has been formed in this century since the "timeline" of the Universe was charted, from the Big Bang up to our epoch – 13.7 billion years. We distinguish three directions (vectors) of the evolution: progressive development – the increase of the structural level of objects; isogressive development – the conservation of the structural level of objects; regressive development – the decrease of the structural level of objects. Natural objects successively pass all three stages of development: in the progressive stage their structural level increases, which causes the formation of new objects; in the isogressive stage the structural level persists and objects maintain their natural being; in the regressive stage objects decay – degrading or dying. This is, in short, the theory of evolution worked out by Charles Darwin.

[1] By *our world* I mean the part of Universe perceivable by human knowledge.

[2] We interpret these approaches by analogy with the following: direct investigation of the object; investigation of the objects as a group from the roof view (disciplinary); consecutive investigation of the objects from the plane view (interdisciplinary); systemic investigation of the object from the satellite view (integrated).

Of these three levels, the progressive evolution presents only one. Its subject is stages of increasing structural level of the objects of "Big History", represented by different scientific disciplines. Thus, physical studies investigate the evolution of the material world; their methods are, limitedly, applied to researches of the organic world (i.e., molecular biology). Biological studies investigate the evolution of the organic world; their methods are limitedly applied to researches of the human world (i.e., psychophysiology). Social studies investigate the evolution of man. The progress of disciplinary studies inevitably results in the regress of the general concept of the world as a whole. This work aims at determining interdisciplinary and integrated concepts of the world.

Interdisciplinary systemic objects of progressive evolution

The amount of scientific information in the result of strikingly successful researches of the world has surpassed the ability of individual comprehension. Inevitably, scientists limit their surveys to discrete fields of knowledge. However, the opposite, unifying, tendency leads to interdisciplinary approaches. Unlike discrete studies, interdisciplinary models do not formulate new scientific laws but disseminate the existing principles onto the objects of related fields, which brings new knowledge and opens new scientific perspectives. Thus, appear new sciences and scientific directions: astrophysics, biophysics, biochemistry, molecular biology, etc. For example, classical genetics would not have been able to discover the genetic code of man but thanks to the laws of molecular physics.

Interdisciplinary approaches also expand onto the world as a whole. They are based on the general principles admitted practically by all scientific disciplines: 1) general principle of evolutionism postulating the evolutionary development of objects; 2) general principle of systemacy determining the element-systemic hierarchical structure of objects. Integrated approaches determine the fundamental attributes of the world – its evolution and systemacy. Let us put forward a question: Is it possible to give the world not an attributive but direct objective determination? Formal logic answers this question negatively: the world is determined as the highest abstract object – and the higher object is impossible. Yet the problem is soluble if we combine evolutionary and systemic approaches and represent the world as the highest evolutionary system[3]. The scientific determination of such a system is possible through its subsystemic constituents. With such attitude, the task is to determine the nearest lower line of systemic objects that present the world as a whole. This line has been known since the Aristotelian times: rock, plant, animal, human. Nowadays the line as the object of study in physical, biological and social sciences has been generalized as

[3] The problem has been discussed in: Г.Л. Зальцман Современное миропонимание – Монография С. 79. Санкт-Петербург: «Наука», 2004; H.L. Zaltsman. Towards a theory of progressive evolution / The Journal of General Evolution.Vol.65, №3, April 2009; http://zaltsmangl.ru/

subsystems of the world, or particular worlds. These worlds are defined as the following succession: material world (universe), organic world (protozoa and plants), animal world, human world. However, this synthesized approach as a whole fails to correlate with discrete fields of knowledge, which we can overcome by introducing the principle of element-system hierarchy. This principle is founded on the following idea: each system comprises the subsystems as its elements, while the system itself is designated as a subsystem within another system of a higher level. The element-system hierarchy is consistent if all its elements are divided into the same groups or sets with the same basis of division. This principle is based on the tetrad category.

The calculus of progressive evolution develops within the two-valued tetrad system of the elements by a general formula of hierarchy applied to the particular worlds and the world as a whole: $A^0_1(a^0_1\text{-}a^1_2\text{-}a^2_3\text{-}a^3_4)\text{-}A^1_2(a^0_1\text{-}a^1_2\text{-}a^2_3\text{-}a^3_4)\text{-}A^2_3(a^0_1\text{-}a^1_2\text{-}a^2_3\text{-}a^3_4)\text{-}A^3_4(a^0_1\text{-}a^1_2\text{-}a^2_3\text{-}a^3_4)$, where *A* stands for systems, *a* stands for elements, 1-4 – atomic number, power 0-3 – space dimensionality. The structural formula of the progressive evolution comprises two parts: convergence and divergence, namely the units of the formula: convergence of the system into the elements (i.e. system-element genesis) and divergence of the elements into the system (i.e. element-system genesis). Two-termed logical propositions about the elements and systems form a four-termed proposition, i.e. a tetra-category, or a reduced tetrad with the following structural formula:

$$A^n_m \left\{ \begin{array}{ll} (a^n_m \rightarrow a^n_m) & \text{- a system of the elements} \\ \downarrow & \text{- convergence into an element} \\ (a_m \rightarrow a^n_m) & \text{- divergence into a system} \end{array} \right.$$

The detailed scientific description of the logical formula is as follows (see Fig. 1):

The epoch of quarks, or the tetrad of quarks. The energy of the Big Bang realizes in quantum fields. In terms of the system-element genesis, gluon fields make a point of null-dimensional mass particles, quarks and leptons, while in terms of the element-system genesis, quarks become a unit of the further formation of open clusters.

The epoch of hadrons, or the tetrad of hadrons. In terms of system-element genesis, quarks in pairs or threes participate in strong interactions to make linear one-dimensional material elementary particles, while in terms of element-system genesis, hadrons become a unit of further formation of open clusters.

The epoch of star formation, or the tetrad of star formation. In terms of system-element genesis, free baryons, protons and neutrons, come into strong interactions to unite into two-dimensional material nuclear clusters of stellar bodies, while in terms of element-system genesis, stars become a unit of the further formation of the thermonuclear celestial bodies.

The epoch of planets, or the tetrad of molecules. In terms of system-element genesis, free atomic nuclei and electrons (leptons) come into interactions to form three-dimensional material configurations of molecules aggregating into planetary bodies, while in terms of element-system genesis, molecules become a unit of the further formation of the molecular-aggregative celestial bodies.

Thus, the particular material world realizes in one-four-level line of the derivative tetrads, which determines the progressive evolution of the material world as a whole.

• The organic world is viewed through the biological model of genome. It investigates the progressive evolution of the organic molecular structures from the metalogic perspective. The element-system conversions become more complex by additional modifying elements, which, ultimately, results in programming self-reproduction of the individuals.

Biosphere, or the tetrad of organic molecules. The system-element genesis of the molecular subsystem forms null-dimensional molecular structures, while element-system genesis forms organic polymers.

Bacteria, or the tetrad of genes. In terms of system-element genesis of the previous subsystem, organic molecules (nucleic acids) produce genetic macromolecular structures, bearers of linear null-dimensional programming information (DNA). In terms of element-system genesis, genes reproduce through read-out of its information by replicating macromolecules (RNA). These agents accomplish matrix synthesis of protein macromolecules to produce genetic system of the individual.

Microbes, or the tetrad of chromosomes. The system-element genesis of a set of genes forms chromosomes, bearers of group two-dimensional programming information, while the element-system genesis is carried out through intermediate changes by chromosomes with half gene pattern. In the daughter cells their full staff reconstructs to reproduce a novel individual.

Fungi and plants, or the tetrad of genomes. In terms of system-element genesis, the combination of chromosomes produce the structure of the cellular genome, which becomes the bearer of the general three-dimensional programming information. In terms of element-system genesis, the half set of chromosomes transfers to reproductive cells and, after their copulation, the full set of chromosomes of the somatic cell restores and reproduces the final multicellular organism.

Thus, the particular organic world realizes itself in one-four-level line of the derivative tetrads, which determines the progressive evolution of the organic world as a whole.

• The animal world is a signal self-regulation of cellular functions of the organism from the metalogic perspective (actual levels of the evolution of animals are based on the evidence of biological disciplines). The element-system shifts become more complex by dually mediated

circulation of elements, which, ultimately, results in programming self-regulative organism of the animals.

Colonial multicellular animals, or the tetrad of mediators. In terms of system-element genesis, multicellular individuals produce point null-dimensional mediator signals for regulating the reversible functions of the species. In terms of element-system genesis, through point null-dimensional mediator signals they combine into humoral-regulated cell receptors and effectors of the organisms, though not reaching the complete integrity of the organism. As the humoral-regulated channel is closed, the integrity of the organism is complete.

Lower animals (invertebrate), or the tetrad of impulses. In terms of the system-element genesis, there takes place a combination of point mediator signals in series excitation which produces impulse signals which spread along the one-dimensional line: environment – receptors – sensory nerves – nerve centers of the marrow – motor nerves – motor and secretory effectors – environment. In terms of element-system genesis, they form differentiated nerve impulse channels of the marrow (see Fig. 3). The environment closes the signal line into a circuit. Thus, the inborn forms of behavior of the organism in its habitat, including complex instincts of the collective behavior of some species.

Higher animals (vertebrate), or the tetrad of images. In terms of system-element genesis, the consolidation of erethic cells into differentiated two-dimensional cellular fields of image-bearing signals. Signals follow a certain order: the environment – modal receptor fields – ascending nerve projection tracts – sensory fields of cortex of cerebral hemispheres – field of associations – motor cortical fields – ascending projection tracts – effector fields – external medium where the reverse transition to excitation of receptor fields takes place. In terms of element-system genesis, the spatial configuration of signals in receptor and effector fields continues in cortical fields and their distribution channels. Typically, spatial configuration of images in receptive fields and effector-specific fields for motor preparation correspond to the configuration of the same images in the fields of the cortex. The inborn behavior of organism becomes trainable.

Higher primates (hominidae), or the tetrad of associations. In terms of system-element genesis, their projection sensory fields are enclosed by derivative association fields that perceive images and keep them in the volume memory. In terms of element-system genesis, mnestic signals of all modal fields concentrate in the associative sphere of occipital lobes of cerebral hemispheres and continue in the associative circuit of the general memory of hemispheres. Transformed in this circuit, the signals proceed into the association sphere of the motor memory of frontal lobes that determine organismal behavior in general. Their signals pass on to the derivative associative motor fields that determine programs of behavior and go further to command motor projection fields. The

environment closes the succession of mnestic signals into a circuit. The behavior becomes projectable and purposeful.

The result of evolution is consolidation of initial elements, functional cells of organism into null-three-dimensional hierarchical lines of tetrads.

• The human world means the sign perception of objects in behavior of an individual and his self-perception from metalogic perspective. The element-system circuits of signals are developed to the higher degree of complexity by reverse circuits. (The levels of the social development of the human world are based on the evidence of social sciences.)

The primitive man – homo sapiens, or the *tetrad of images*. One of the cerebral hemispheres becomes dominant. In terms of system-element genesis, in the dominant cerebral hemisphere, null-dimensional local foci of excitation rise in its representative associative fields and as abstract signs correlate with real and mnestic sensory and motor images. In terms of element-system genesis, concepts appear as initial elements of consciousness and subconsciousness, which comprise mnestic sensory and motor signs and mnestic sensory and motor associations. In the course of maturing, there prevails either associative or abstract thinking. Their regulation becomes possible by trial and error. Then it forms a minor circle of the intellectual sign circuit in the result of the feedback loop of motor and sensor images in the subconscious memory associations. Within the human circadian balance, the period of subconscious thinking is not inferior to conscious reactions, while the period of subconscious behavior, automatic actions in particular, by far exceeds the period of conscious behavior. Due to these accomplishments, self-consciousness of an individual elevates Man above Nature. He is able to represent objects of the environment and cognize them by means of intellectual signs. Since that moment, the evolution of ideal objects will carry on the progressive evolution of material objects. Consciousness and self-consciousness of an individual lies in the foundation of subsequent forms of social thought.

Speech community, or the tetrad of words. The initial system-element genesis of the body movements and their perception produce one-dimensional linear channels of interpersonal speech relations between a speaker and a listener, while in the course of the element-system genesis, there derives collective social mind, i.e. speech acts and their perception by the speaker and listener. Then it forms a minor circle of interpersonal relations between the speaker and listener and conventionally adopted means of verbal communication in the speech community. They determine his motor ideas, and interpersonal relations develop in the reverse order. This is formed the interpersonal channel of verbal communication. Mastering his verbal skills, the individual acquires the opportunity to determine social relations of his speech society.

The civilized society, or the tetrad of cognition of object relations. In terms of system-element genesis, monomial verbal naming of surrounding objects by a speech community is not suffice to

determine their relationships. The latter is achieved by binomial logical thinking. It determines logical objects through a set of their attributes. In terms of element-system genesis, determinations are realized in the ideal sphere of the object thinking. It extrapolates ideal objects onto the reality where real objects are determined by real attributes. The results of every such determination undergo reverse transformation by object thinking into ideal space as a set of causal attributes of the object. The circuit of the object mind reaches, by trial and error, the correlation n between objects and their attributes in the real and ideal space. Objects and attributes take the form of binomial causal logical propositions – images whose meaning becomes the relations between their prototypes – real objects. Thus, personal logical propositions form the intellectual verbal sign circuit. The individual gets the opportunity to determine relations between surrounding real objects. It gives rise to science, engineering, arts etc.

The informational society, or the tetrad of cognition of general natural relations. In terms of system-element genesis, formal logic considering relations of the particular worlds does not suffice to determine them as stages of the progressive evolution of our world as a whole. Such determination requires comparing the structure and organization of every previous and subsequent world. For this purpose, we can use specialized formal tetramerous metalogic determining the intellectual circuit of inferences. In terms of element-system genesis, it opens the opportunity for direct integrated scientific definition of particular worlds as stages of the progressive evolution of the world as a whole in the process of nature-related thinking. (We will dwell upon the subject in the next part.)

Thus, the human world completes the formation of one-four-dimensional hierarchical line of the progressive evolution of the world as at large. Its null-three-dimensional constituent elements make the following succession: point realization of energy in the material world; lines of advancing programmed reproduction of structures of the organic world; advancing-reciprocal signal regulating of organismal functions of the animal world; sign intellectual representation of personal and interpersonal fundamental relations with the environment in the individual human mind.

Integrated informational objects of the progressive evolution

In this article, we apply an informational approach towards the description of the integrated informational objects and operations of the progressive evolution of the world as a whole. The universal operations are as follows: convergence, or informational coding ($\vee$), divergence, or informational decoding ($\wedge$) and transcoding (-). The elements and systems are determined by a binominal statement, or proposition, quadrinomial propositional system, which incorporates binominal logical propositions and referred to as a metalogical proposition, or a tetra-proposition,

shortly, a tetrad. Thus, a composite metalogical proposition is regarded as a tetrad sequence, which is approached as a form of the progressive evolution of the particular world and the world as a whole. (See Fig. 1 and 4). In the previous parts, we gave their scientific interpretation. The next part focuses on informational objects and operations.

- The material world is based on the standard model in physics. It metalogically accounts for the progressive evolution of the discrete objects of the material world. (See Fig. 1, 2).

The epoch of quarks, or the tetrad of quarks. Gluon fields converge into initial quantum null-dimensional forms of substance – into quarks and leptons. Accumulating, quarks diverge and interact and then reverse into gluon fields.

The epoch of hadrons, or the tetrad of hadrons. On the next stage of evolution singular one-dimensional interactions of quarks converge into hadrons. Accumulating, they diverge and interact, while also reversely diverge into constituent quarks.

The epoch of stars, or the tetrad of atoms. On the next stage, interactions of hadrons converge into atoms. Accumulating, they diverge and interact and then reverse into constituent hadrons.

The epoch of planets, or the tetrad of molecules. On the next, ultimate, stage of evolution the three-dimensional interactions of atomic nuclei and leptons fully converge into molecular structures. Their stable state is determined by the ultimate materialization of energy. Thus, in the course of evolution, the material world and its initial quantum-energy structures progress thrice and complete with the molecular-aggregate formation of planets.

- The organic world, or the tetrad of organic molecules, is determined through coding of multitudes of atoms into organic molecular structures and decoding into multitudes of polymeric systems.

Bacteria, or the tetrad of genes. Organic polymeric of nucleotides code into genetic macromolecules – bearers of programming information. They transcode into reproducible macromolecules and decode through matrix synthesis of protein macromolecules of a cellular self-replicating individual.

Microbes, or the tetrad of chromosomes. Group compounds of genetic macromolecules for the second time code into initial structures of chromosomes. Their sets transcode into genetic half sets of daughter cells and decode, forming cellular self-replicating individuals.

Multicellular plants, or the tetrad of genomes. Complete set of chromosomes codes into three-dimensional structure of cellular genome. Genome recodes into programming structures of reproductive cells with a half set of chromosomes. After copulation, chromosomes decode into somatic cells that differentiate and integrate into a multi-cellular organism. Thus, in the course of evolution of the organic world, its initial reproducible molecular structures progress thrice as

bearers of programming information and complete with formation of somatic cells of an individual.

Colonial animals, or the tetrad of mediators. Excitable somatic cells code into null-dimensional mediator humoral signals reverse sensory and motor functions of the animal organism. At the initial self-regulation of cellular functions through humoral signals, receptor cellular signals transcode and diverge into effector acts. As the humoral-regulated channel is closed, the process of ensuring integrity of the organism is complete.

Lower animals, or the tetrad of impulses. On the next stage of evolution, linear transformations of regulating cell signals take place. Receptor sensor signals of various modality code into signals of sensory nerves. In the nerve centers of the body marrow sensory signals transcode into motor signals of motor nerves and decode into executing motor actions. In the environment occurs the reverse motor-sensory transcoding along the line: environment – receptors – sensory nerves – nerve centers – motor nerves – effectors – environment. (See Fig. 3).

Higher animals, or the tetrad of images. On the next stage of evolution grouping, one-dimensional impulse signals code into regulatory signal images of various modality. They transcode into associations in the fields of the cerebral cortex. Through resulted associations, they decode into descending signals. Their commanding signals descend along conductors and decode into effector acts of motor fields along the line: receptors – ascending trajectory paths – sensory fields of the cerebral cortex – fields of sensory and motor associations – motor cortical fields – descending conduction paths – effectors. In the environment, motor images reversely transcode into sensory images.

Higher anthropoids (hominids), or the tetrad of associations. On the next, ultimate, stage of evolution, images issued from modal sensory cortical fields accumulate in derivative sensory associative fields of memory and code into the sensory sphere of occipital lobes of cerebral hemispheres. Then they transcode within the associative system of common memory and go to the motor sphere of the associations of frontal lobes; then they decode within the derivative associative fields of motor memory. Mnestic signals determine images of projecting motor fields, and their commanding signals go to the executors. In the environment motor associative signals of organism transcode into sensory signals.

- The human world, or the tetrad of concepts, is determined as sign self-consciousness of an individual represented in the intellectual, sensory and motor sphere of consciousness. In the dominant hemisphere, sensory images of the memory converge into abstract local null-dimensional signs, representations of ideal intellectual sphere of consciousness. The consciousness transforms them into ideas of real behavioral sphere where they diverge into separate active motor operations.

Speech community, or the tetrad of words. Personal representations-meanings and representations-expressions of members of the speech community code into the ideal sphere of social consciousness. Conventional social consciousness transcode them into the real sphere and decode into expressive behavioral operations of members of the society. Circuits of social consciousness end in world-building that fixes univocal correspondence between meaning and expression accepted by the speech society.

Civilized society, or the tetrad of propositions. On the next stage of evolution, social consciousness of the civilized society not only names objects of the surrounding world but constructs from them binomial logical propositions that define objects by their common attributes. These circuits correspond with relationships between real and ideal objects and their attributes in the objective mind.

Informational society, or the tetrad of deductions. Metalogical propositions representing particular worlds gradually code into the ideal sphere of natural intellect and then transcode into real sphere where they decode into interrelationships of the particular worlds placed on the closely-related stages of evolution.

Resume

In brief, this is an interdisciplinary logic model and integrated metalogic model of the progressive evolution of the world at large. The world is determined as succession of tetra-categories (di-contrapropositions) of particular worlds: realization of energy of the material world, organic world, steady-reverse programmed reproduction of structures of the organic world, steady-reverse signal regulation of the organismal functions of the animal world, sign intellectual reflection of internal and external relations in the human consciousness. Each particular world is regarded as a binomial tetrad of hierarchical objects.

This interpretation of Nature allows considering its Creator in a new way. He has the existing Media in one hand and Structures in the other, building them on by changing His hands. The result is new worlds. It took sixteen days to create our world (one day of Creation corresponds to a stage of evolution).

The philosophical aspect of the progressive evolution may be represented in the following foundations:

- The material world – the formation and progress of the Object;
- The organic world – the formation and progress of the Subject within the Object;
- The animal world – the formation and progress of relationships between the Subject and Object;

- The human world – the formation and progress of the Object within the Subject. Thus the circle closes as predicted by Hegel more than two centuries ago.

The epistemological aspect is as follows:

WHAT? – is a subject-matter, i.e. the regularities of the progressive evolution of the world;

HOW? – the progressive evolution of the world proceeds, i.e. contradirectional, steady-reverse transformations of the systems into elements and elements into systems as hierarchical one-four-level line-building of the particular worlds.

WHY? – since the evolution steadily proceeds in time and simultaneously occurs in null-four-level space of our Universe.

P.S. Natural evolution as a prototype of the artificial intellect

In the informational society, scientific researches lead to constructing models of objects under investigation. Physicists have succeeded in corroborating the standard model of the progressive development of the material world (quarks – hadrons – atoms – molecules). Biologists have managed to construct the genetic model of self-reproduction of individuals in the organic world (organic molecules – genes – chromosomes – genome). To the author's view, the animal world is a hierarchy of signals regulating the organism (mediators – cellular excitation – organ images – associations). Higher animals (vertebrate) combine signals into group organ images. The line of regulating develops as follows: environment – receptor fields – ascending nerve tracts – sensory projecting fields of the cerebrum – joint hemisphere associations – motor projecting fields – descending nerve tracts – effector fields – environment. The environment provides motor-sensory recurrence of images. Behavior becomes trainable. The higher anthropoids (hominids) turn their regulative signal for activating associations in the volume memory. The line of regulation is as follows: environment – initial projecting sensory fields of the cortex – derivative identifying associative sensory fields – general volume of associations in the sensory memory of occipital lobes – associative net of common memory – common volume sphere of associations in the motor memory of frontal lobes (determines the behavior of organism) – derivative associative motor fields (determine programs of organismal behavior) – initial commanding projecting fields. The behavior becomes planned and purposeful. No models of the artificial intellect can yet achieve the level of cerebral complexity of hominids.

The progressive evolution of the human, to the author's mind, can be interpreted as a hierarchy of sign modes of cognition (representation – word – proposition – deduction). On of the cerebral hemispheres, the top regulating organ of animals, becomes dominant. Its representative fields activate local excitations as signs corresponding to images of the sensory and motor memory.

Sensory signs-representations become units of intellectual ideal sphere of mind. It elevates Man by opening to him the opportunity of reflecting properties of Nature. In the course of progressive evolution of Man, his personal intellectual sign-circuit mediates through the following stages: 1) through the circuits of meaning and expression of every word in the ideal and real spheres of the social consciousness cognizing interpersonal relations within the speech community; 2) through the circuits of logical objects and their logical attributes in the ideal sphere of the objective consciousness transformed in its real sphere into relations between objects and their manifestations, cognizing objective relations within the civilized society; 3) through the circuits of metalogical, informationally represented particular worlds in the ideal sphere of the nature-related consciousness, which, in its real sphere transform into relations between particular worlds in the course of progressive evolution, cognizing progressive evolutionary relations of the world at large accepted in the informational society.

If it may be accepted as a prototype of the artificial intellect, our goal will be achieved.

Fig. 1. The succession of the progressive evolution of the world: interdisciplinary (1), integrated (2) and their calculu **1** **2**

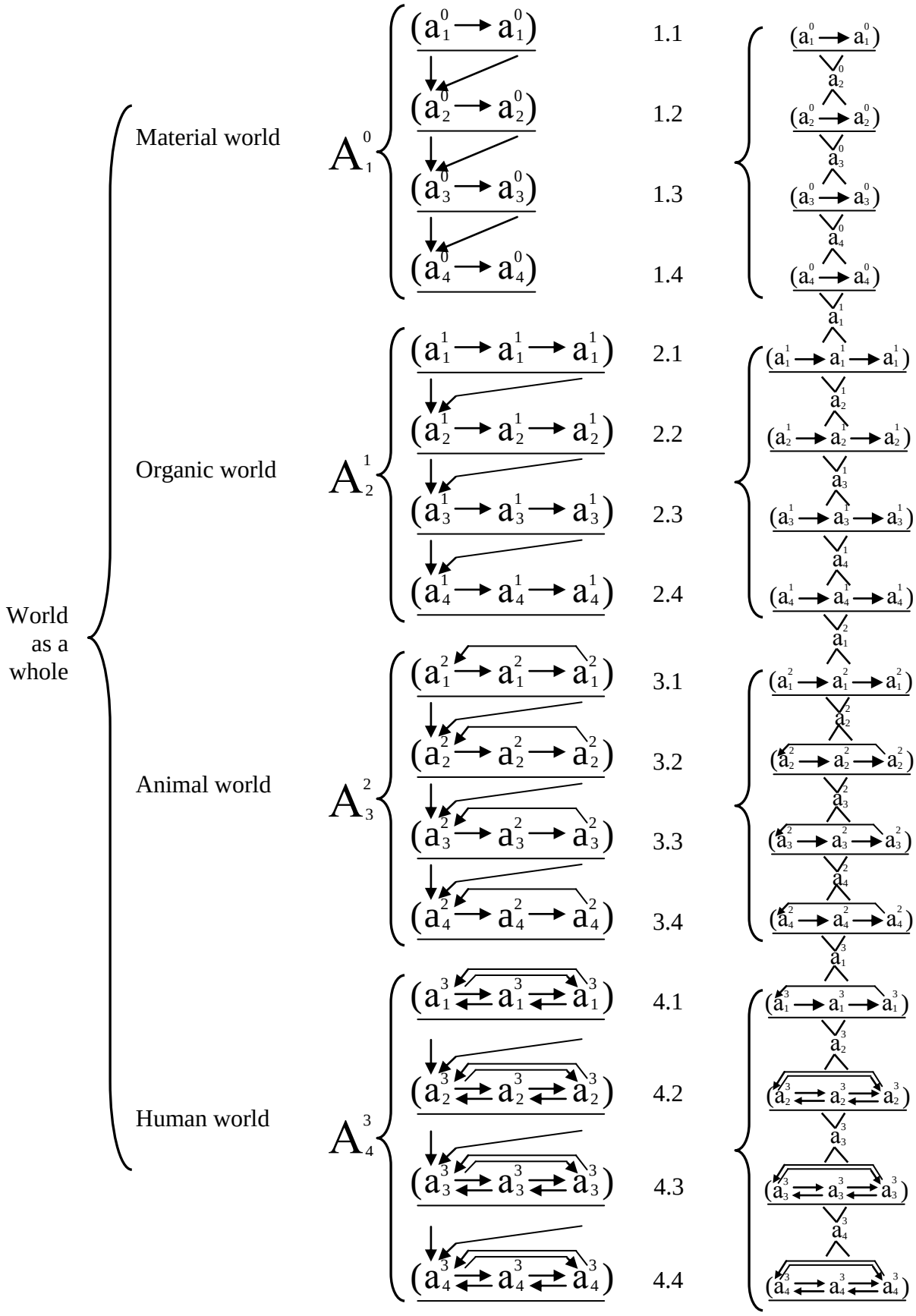

Fig. 2. Interdisciplinary scientific system of progressive evolution

NN	Stages of progressive evolution	Hierarchical one-four-dimensional line of elements	Hierarchical one-four-level line 3asystems
The material world of realization of quantum energy			
1.1	Early universe, the epoch of quarks	Quarks	Initial realization of gluon quantum fields forms quarks
1.2	The epoch of hadrons	Hadrons	Primary material realization of energy of interaction between quarks forms hadrons
1.3	The epoch of stars	Atomic nuclei	Secondary material realization of energy interaction between hadrons forms atomic nuclei
1.4	The epoch of planets	Molecules	Tertiary material realization of energy interaction between atoms forms molecules
The organic world of programmed reproduction of molecular substance			
2.1	Biosphere	Organic molecules	Initial forming of self-reproducing combinations of organic molecules
2.2	Bacteria	Genetic macromolecules	Primary forming of organic molecules reproduces genes; genes reproduce macromolecules
2.3	Microbes	Organoids – chromosomes	Secondary forming of genes reproduces chromosomes, and they reproduce other organoids
2.4	Fungi, plants	Cellular genome	Tertiary forming of chromosomes introduces genome, and it reproduces multicellular organism
The animal world of signal regulation of programmed cellular structures			
3.1	Colonial animals	Humoral signals of organism	Initial self-regulation of cellular functions realizing motor acts
3.2	Lower animals – the invertebrate	Linear signals of the central nerve system	Primary regulation of cellular functions realizing inborn modes of behavior
3.3	Higher animals – the vertebrate	Projecting image signals of the cerebrum	Secondary regulation of organ functions realizing trainable behavior
3.4	Higher anthropoids - hominids	Associative signals of memory in the circles of superior spheres of the cerebrum	Tertiary regulation of the systemic functions of organism realizing purposeful activity
The human world of sign determining of regulated relations of organism			
4.1	Primitive community of homo sapiens	Abstractions	Initial conscious sung cognition of personal relations
4.2	Speech community	Monomial thought – the word	Primary verbal sign cognition of social relations
4.3	Civilized society of logical thinking	Binomial thought – logical proposition	Secondary logical sign cognition of objective relations
4.4	Informational society	Tetranomial thought – logical deduction conclusion	Tertiary metalogical sign cognition of relations of the world at large

Fig. 3. STAGES OF THE PROGRESS OF MENTAL ACTIVITY

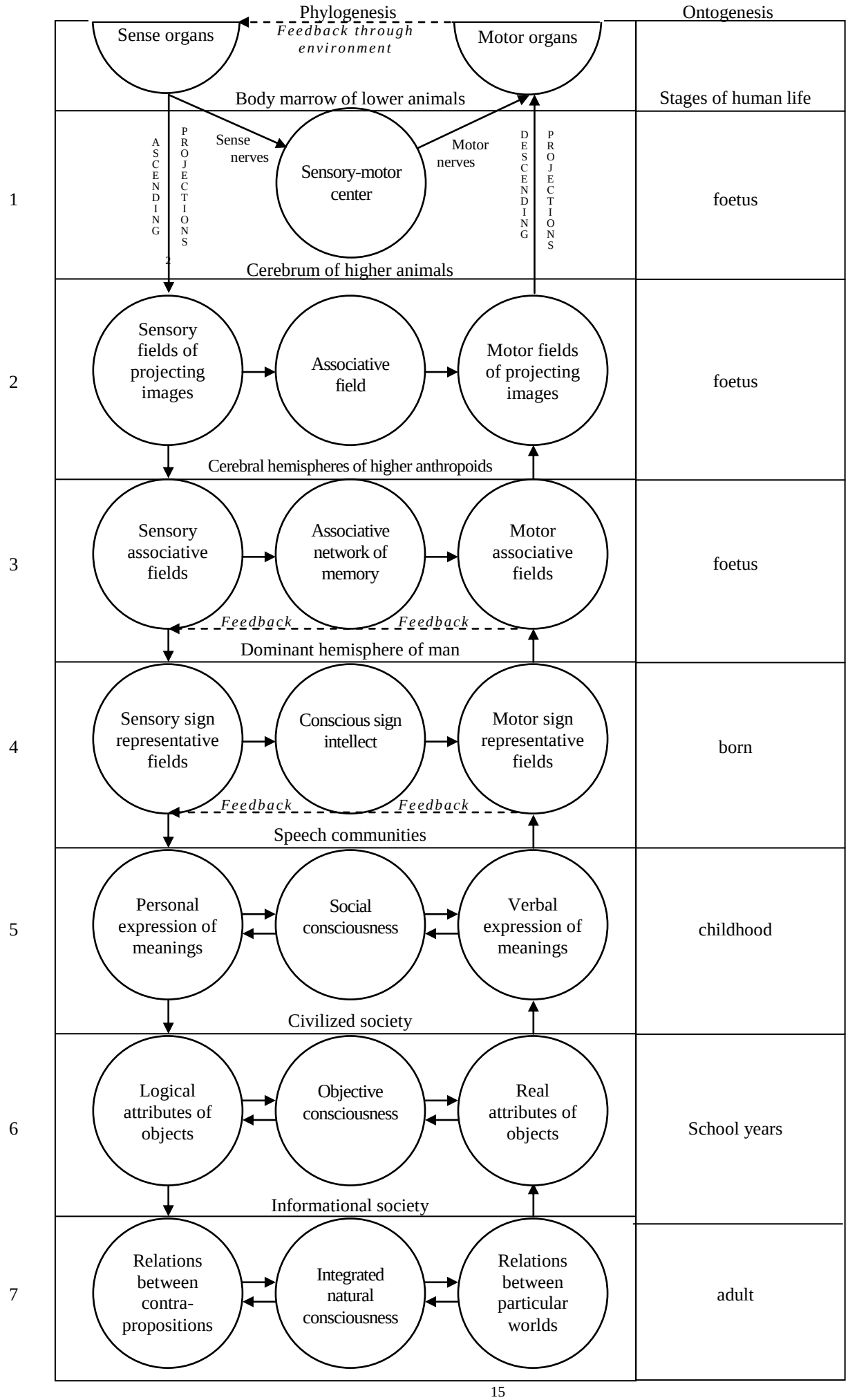

Fig.4. Integrated scientific informational model of progressive evolution of the world