
Global extinctions and the biological evolution

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Golubev VM 1995. Global extinctions and the biological evolution. *Palaeobotanist* 44 1-8.

The biosphere evolution is shown to accompany geodynamic processes and follow different-order cycles of the galactic motion of the Solar System. Restricted to critical points of the cycles are global epochs of nascencies and extinctions of taxa whose rank corresponds to a scale of geodynamic activation at their origin in critical points of the Earth's surface. Mutations are induced by a cyclic increase in cosmic radiation and provided by synchronous variations of geophysical fields. Rhythmicity of physical fields at taxa nascencies is fixed in genotype of organism to form their biorhythms and typical response degree to variations of the fields, reflected in stage-by-stage pattern of their life cycle. Desynchronization of the biorhythms with physical rhythms causes taxa extinctions or re-nascencies that is stimulated by simultaneous catastrophic changes in habitat conditions.

Key-words— Cosmodynamic cycles, Geodynamic cycles, Biological extinctions, Mutations, Biorhythms, Natural selection, Physical phylogenesis, Biosphere.

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सारांश

भूमण्डलीय विलुप्तीकरण एवं जैविक विकास

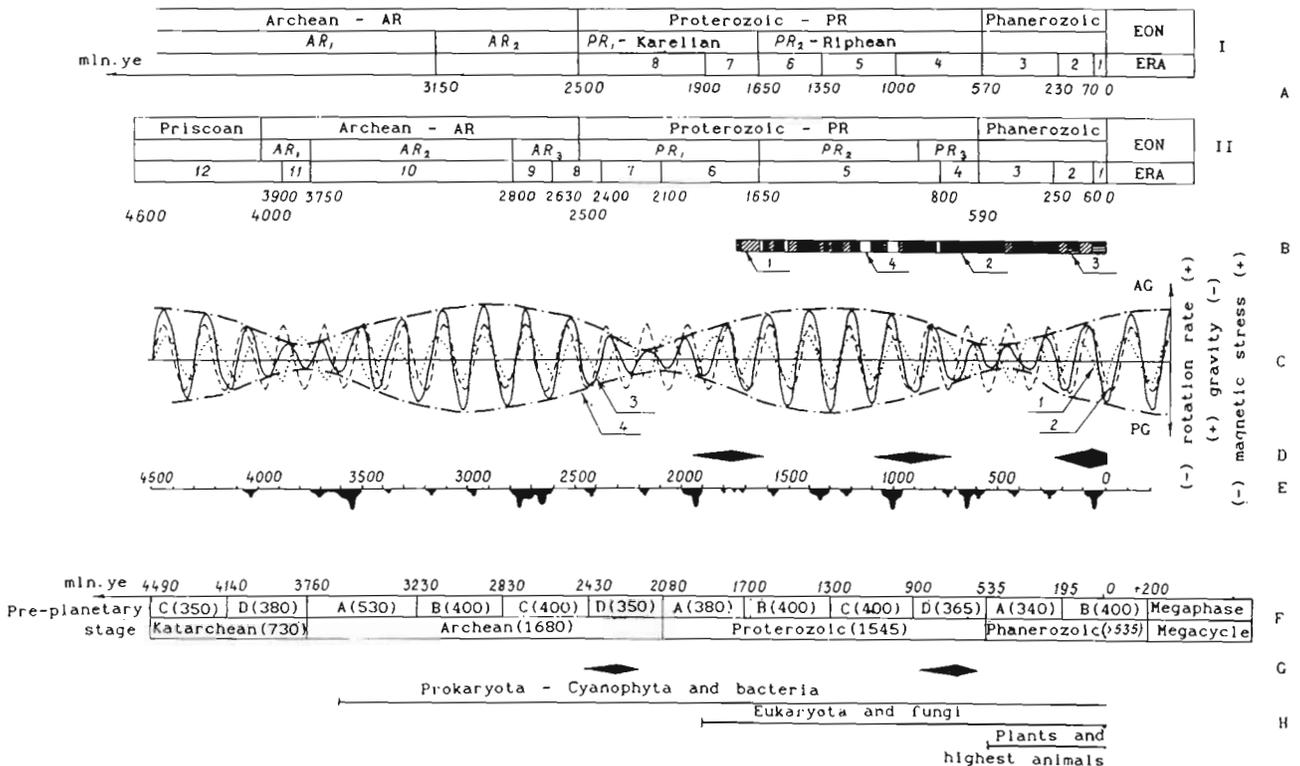
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जैवमंडल का विकास भूगतिकीय प्रक्रमों के फलस्वरूप हुआ है जो सौर मंडल के गैलेक्टिक गति चक्रों के अनुरूप है। इन गति चक्रों के विशेष बिन्दुओं से भूमण्डलीय महाकल्पों में विभिन्न वर्गों का प्रादुर्भाव अथवा विलुप्तीकरण जुड़ा हुआ है। कॉस्मिक विकीरण में चक्रीय वृद्धि एवं भूभौतिकीय क्षेत्रों में विभिन्नता के कारण उत्परिवर्तन होते हैं। जैव-तालों एवं भौतिक तालों में परस्पर तालमेल न होने के कारण वर्गों का विलुप्तीकरण अथवा पुनः प्रादुर्भाव होता है परिस्थितियों में साथ-साथ प्रलयकारी परिवर्तनों के फलस्वरूप तीव्रता भी आती है।

AS inferred from the analysis, stages of life development on the Earth, like geological processes, are controlled by resultant cosmophysical cycles of the Solar System motion around the Galaxy core, which composes sinusoidal geodynamic cycles, geotectonic ones included (Golubev, 1992a, b, 1993). Epochs of biosphere realignments are restricted to critical (turning) points of geodynamic megacycles of 1550-1700 million years, megaphases of 350- 530 million years, cycles of 155-195 million years and phases of 25-65 million years, spaced from them at 5-10 million years (Text-figure 1). The realignments are expressed in mass and global extinctions of diverse biological forms at the end of different-order geodynamic cycles and in nascencies of new ones at the onset of the following cycles.

Analogous relations are inferred for the Phanerozoic from dynamics of nascencies and extinctions of 2250

families of major groups in animal kingdom (Newell, 1967; Salop, 1977), the staged development of plant kingdom (Meien, 1986) and the formation of hydrocarbon deposits (Golubev, 1989). Mass extinctions at the end of Ordovician, Devonian, Permian, Triassic and Cretaceous are supported by the latest investigations. Extinctions of 3500 families of aquatic animals are established to show cyclicism as 34 million years in the Paleozoic and 26 million years in the Mesozoic-Cenozoic (Raup & Sepkoski, 1984; The march..., 1989). The progressively justification of global extinctions has revived an idea of the catastrophic character or more properly the intermittent course of geoevolutionary and bioevolutionary processes (Katastrofy..., 1986), which was developed early in the XIX century by J. Cuvier in terms of multcreationism (multiple creative acts).



Text-figure 1 — Galactic megacycles of the Earth's motion since its formation as compared to geodynamic and biological processes. A. General geochronological scale, eras: I (Semikhatov *et al.*, 1991): 1 — Cenozoic, 2 — Mesozoic, 3 — Paleozoic, 4 — Late Riphean, 5 — Middle Riphean, 6 — Early Riphean, 7 — Late Karelian, 8 — Early Karelian; II — (Harland *et al.*, 1982): 1 — Cenozoic, 2 — Mesozoic, 3 — Paleozoic, 4 — Sinian, 5 — Riphean, 6 — nameless, 7 — Huronian, 8 — nameless, 9 — Randalian, 10 — Swazian, 11 — Isuan, 12 — Hadian. B. Polarity of geomagnetic field (Paleomagnetologiya, 1982): 1 — direct, 2 — reverse, 3 — variable, 4 — non-studied. C. Dynamics of Earth's motion around the Galactic core: (+) increase (-) decrease of geodynamic parameters; AG apogalaction, PG perigalaction; 1-4 cyclicisms: 1 — siderial, 2 — anomalous, 3 — resultant, 4 — megaresultant. D. Epochs of plateau-basalt volcanism (Makarenko, 1983). E. Epochs of tectonic-magmatic diastrophisms (Salop, 1982). F. Cyclic geodynamic scale and duration of its subdivisions in million years. G. Major glacial epochs (Salop, 1977). H. General development stages of organic kingdom (Sokolov, 1976)

In biorevolutionary epochs, different-order taxa: species, genera, and families extinct, on the geological scale, virtually in a moment (from thousands to first millions of years), though being usually preceded by their gradually decreasing inner diversity. The biorevolutionary epochs are characterized by the global disappearance or abrupt decrease in number of taxa being mostly as late as at a stage of the evolutionary decline. Their living space is occupied by new or already existing bioforms entering a stage of the evolutionary rise or bloom. The greatest realignments in animal kingdom at boundaries of geodynamic cycles are preceded by realignments in plant kingdom early in the terminal phase of the cycles. The exception is provided by the Cenozoic and Cenophytic being the last eras of animal and plant development. These epochs are discerned likely owing to a naturally exaggerated impor-

tance of recent impressive biological events, especially as the Cenozoic onset is not expressed quite in relief in the chart of animal kingdom development (Newell, 1967; Raup & Sepkoski, 1984), as well as to the increasing life diversity providing more space for biological realignments.

Aging the degradation of bioforms accompanied by their morphotype complication and extra-specialization are considered a major prerequisite for taxa extinctions and also explained by various inner and/or outer factors (Davitashvili, 1969; Sovremennaya paleontologiya, 1988). Exhaustion of taxon life potential and/or its loss in changeability are usually referred to inner factors. These factors provide the basis for autogenetic (vitalistic) concepts of phylogenesis (macroevolution of living), implying entelechy of organisms that is a perfection-directed vitality. Such an approach is the essence of the

first evolutionary doctrine developed by J.B. Lamarck late in the XVIII century. The doctrine explains the life development by spontaneous nascencies and continuous complications of organisms under environmental influences, which are fixed by organ training and inherited.

External factors of extinctions were grown in significance after a discovery of natural selection by Charles Darwin in the mid-XIX century and organism mutations by G.I. Mendel in the late XIX century, which provided the base for Neo-Darwinism (synthetic) evolution theory. External factors involve in environmental changes: climatic and atmospheric (Budyko, 1984), geochemical (Neruchev, 1982), geotectonic and landscape (Lichkov, 1965; Krasilov, 1985), geophysical and cosmic ones, including flares of supernovae and falls of meteorites (Kosmos..., 1974; Shugrin & Obut, 1986; The march..., 1989). However, each of these factors being sure to provoke taxa extinctions, and ecosystemic combination of the factors are inadequate to explain a phenomenon of global biological revolutions with extinctions of old bioforms and nascencies of new ones. A selective rather than a universal synchronization of nascencies and extinctions of single-rank taxa, though occurring everywhere, and an attendant evolutionary rise of other taxa demonstrate the equal participation in phylogenesis of inner and outer factors both, which may be nevertheless controlled by a single cosmophysical mechanism.

New bioforms appear commonly at the onset of geodynamic megacycles, cycles and phases, whereas their development stages composing four phases of taxon life cycle follow the inner structure of these cycles or to cycles lower in rank. Stages of taxa formation, maturity, aging and degradation can be pair-wise united in life semicycles or stages of the evolutionary up and down. The evolutionary flexibility (stability) and the relevant taxonomic importance of bioforms directly depend upon a rank of geodynamic cycles beginning or inverting in moments of taxa nascencies. The interrelation of different-order geodynamic cycles is thus reflected in a hierarchic structure of organic kingdom, that supports the reality of the highest taxa and the systemic organization of biosphere. We can suggest that a scale of variations of cosmophysical and geophysical fields in critical points of different-order geodynamic cycles provides nascent taxa with a similar by level

biopotential to be realized during their life cycles. A duration of their life cycles is, in its turn, controlled by a rhythm of physical fields' parametres approaching to an initial for taxa level.

The phylogenesis itself may be related to genomic mutations in critical (turning) points of the Solar orbit. Mutations become more frequent and strong primarily at the time of maximum solar activity and the increased cosmic radiation of solar origin (solar wind) due to intensifying thermonuclear reactions in the Sun interior. At the time of minimum solar activity at opposite nodes of solar orbit, mutations are induced by the cosmic radiations of galactic origin. The cosmic radiation consists mostly of protons (nearly 90%) and alfa-particles (7%) as well as electrons, nuclei of heavy elements and other elemental particles which interact with the Earth's atmosphere and generate the secondary radiation. Therewith, galactic particles, neutrino especially, show the abruptly increased (10^{10} - 10^{21} eV) kinetic energy as compared to solar particles (less than 10^{10} eV), that improves their ability to weaken and destroy the less stable molecular bonds in genotype some parts of which are extra-variable.

An alternate intensification of high-energetic fluxes of the solar and galactic radiations destabilizes to a variable degree the molecular structure of genotypes and realigns it at synchronous inversions and variations of the gravitational and electromagnetic fields of the Earth. Inversions of the geomagnetic field's polarity augment an effect of the cosmic radiation due to the abrupt decrease (down to zero) in the field intensity. The field is no longer acting as a shield against the cosmic radiation mostly because of dis-compactions and ruptures of a thin (about 3 mm as a total) ozone layer. Geophysical variations per se are likely able to the less energy-intensive re-orientation (modification) of electrochemical bond in genotype which does affect the general structure of a cell and its typical biophysical field. Such realignments of genotype may be analogous to the orientation by the geomagnetic field of the crystalline structure of minerals isolated from the cooling magma. The minerals preserve directionality and intensity of this field that is reconstructed by the paleomagnetic analysis of rocks. The orientation of growing crystals like their possible liquid analogs (cells) is expressed by the optic axis of crystals turning parallel to lines of forces of the magnetic fields, as noted by M. Faradei.

Genomic mutations are known to be the most important realignments of genotype of a reproductive cell. They change a number of chromosomes while chromosome and gene mutations change the structure of chromosomes and their functional units (genes). Eruptions of the hard radiation being considered (as shown by O. Schindewolf) the leading mutagenic factors (Davitashvili, 1969) evidently result in lethal changes in genotype and constitution of degrading taxa and in the formation of new bioforms. Extremely specialized and degraded bioforms with the unstable genotypes may serve as a base for genomic mutations. To judge from the arranged pattern of cosmophysical and geophysical cycles, the life cycle of taxon development (hologenesis) is imagined in the genetic aspect as a multi-level row of microevolutionary chromosome and gene mutations often similar (homologic) of related taxa. The mutations realize genomic potential of taxon whose structural possibilities localize and direct realignments. The genomic potential itself may be the carrier and indicator of taxon vitality that provides its self-development.

Inversions of geophysical fields become more frequent and strong in geodynamically active Earth's regions controlled by lines and nodes of a network of the planetary joint; the network reflecting a structure of the fundamental informative-energetic geodynamic field (Golubev, 1992a). The structure of forces of the geodynamic field is expressed also by lines of the abruptly changing structure of geophysical and geochemical fields and axes of their anomalies. The planetary jointing network forms, therewith, an arranged (from thousands of kilometers of tens of meters) symmetric-desymmetric ornament of the crustal relief and soil structure, reflecting a structure of geophysical fields and resembling the cell structure of organisms (Stepanov, 1986). Such a resemblance suggests the geodynamic field to participate in organisation of inanimate and animate nature at its leading systemic levels.

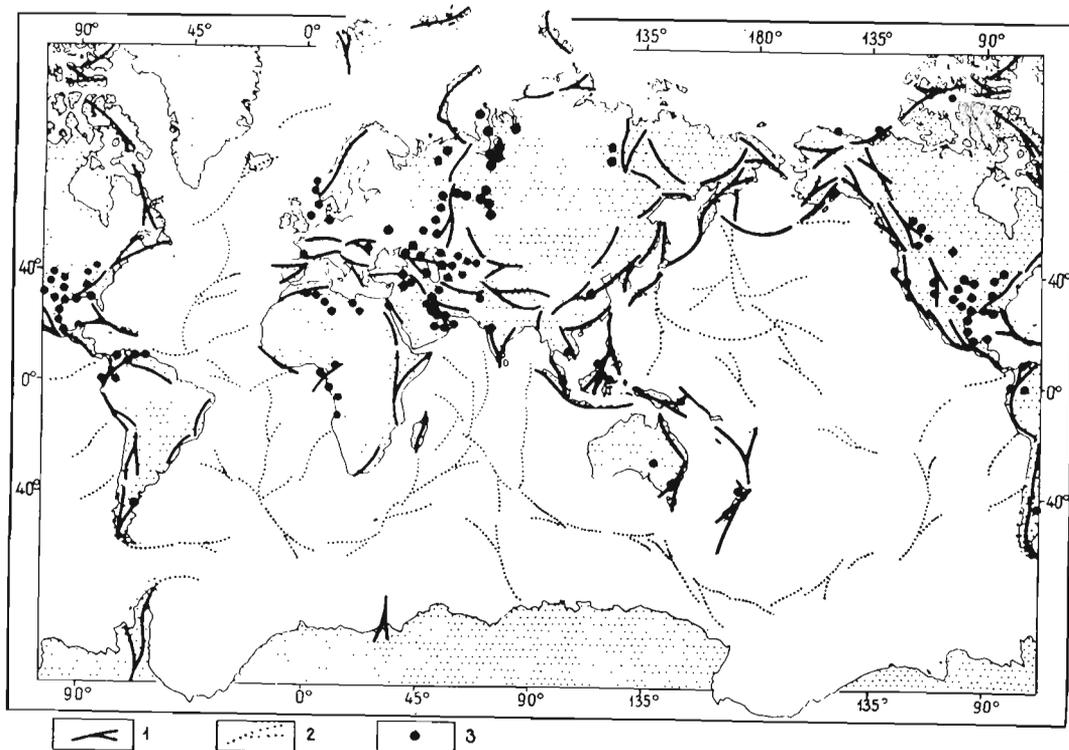
The energetic anomalous pattern of the crustal jointing network results not only in the activity of attendant zones in hydrosphere and atmosphere but in the areal-zonal activity of biosphere as well. Biogeographical provinces and areas of the Earth are limited by lines of the planetary jointing, distinguishing regions with uniform geological and landscape-climatic conditions. Habitats of many species of organic kingdom often stretch along large faults and surround their nodes.

Seasonal and spontaneous wave-like migrations in animal kingdom, especially typical of birds, fishes, insects and to some extent of man also proceed along global crustal faults and are stimulated by different-order cyclic variations of the geodynamic field.

Stability of species habitats appears to be caused by nascencies of new bioforms in areas of geodynamic nodes that are critical points of the Earth's surface. Their rank is indirectly expressed in that of taxa appearing due to different-scale physical mutations, and the areas themselves become for them related. Physical parameters of geodynamic nodes, landscape-climatic ones included, show elements of the planetary symmetry that directs seasonal and spontaneous migrations. The geodynamic control for speciation is supported by the fact that foci of the intraspecific variability of chromosomes (carriers of genetic information in a nucleus of the reproductive cell) are confined to seismically active zones (Vorontsov & Lyapunova, 1984) and that species of animal and plant kingdoms are 2-5 times more diverse in the mountains.

The geodynamic control for mutations explains the revealed by N.I. Vavilov (Alexeyev, 1984) irregularity in the geographical location of different-age centres and foci of generating cultivated plants and domestic animals by naturally enriched genetic funds and highly bioproductive biogeographical areas and regions of the Earth. Such speciation foci, anthropogenic included (Golubev, 1994), are confined to the global continental belt of fold-block-faulted deformations (Text-figure 2) that may be considered a major speciation belt on the Earth whereas speciation centres are situated in regional structural nodes. Areal of the anomalous bioproduction present as hydrocarbon deposits whose stratigraphic distribution is regulated by global and regional cycles of the geodynamic and biological activation (Golubev, 1989).

The biological anomalous character of the planetary jointing network is also controlled by various geochemical processes which intensify in crustal fault zones and provide them with the increased contents of biologically active chemical elements and compounds being frequently mutagenic (Vernadsky, 1987). Geodynamic stimulation is demonstrated by the life bloom around hydrothermal sources of continental and oceanic rifts, at foots of continental slopes and on sea peaks, usually volcanoes often crowned with coral reefs. In all the



Text-figure 2— Location map of global strain belts and major oil and gas deposits. 1, 2 — axes of belts: 1 — continental, 2 — oceanic, 3 — hydrocarbon deposits (Burolet, 1984).

instances, over the largest faults and their nodes, narrow enough zones and local foci of the intense life development with the extended species composition, endemic and anomalously large bioforms appear. Bioproduction is more increased in near-fault zones of the continental slope due to amplified hydrodynamics, including upwelling with the ascent of deep cold waters saturated with mineral nutrients.

The anomalous pattern of physical-chemical processes in nodes of the geodynamic network attributes the life initiation to the organic synthesis at extreme inversions of cosmophysical and geophysical fields. The biological activity of the geodynamic network causes mutations to grow in local geographical areas: speciation centres involving not only some individuals but entire populations as well. Mass uniform mutations create conditions for intra- and inter-specific natural selection and as a result direct phylogenesis.

Hence, extreme inversions and variations of cosmophysical and geophysical fields cause the cyclically complicating organization of the living matter; the global and the regional components of the fields are, therewith, responsible for the genetic resemblance and difference of sub-taxa, respectively. The geological-geodynamic

structure of the regions forms as well their geochemical, landscape and climatic features favouring the geographic isolation of taxa, that provides fixation of their peculiarity. Such a global-regional mechanism of phylogenesis unites monophyletic and polyphyletic concepts of life generation. The latter has common cosmophysical sources which feed in geodynamically active Earth's regions a uniform cyclically branching phylogenetic tree reflecting the complicating and regionally differentiating structure and crust of the Earth. The tree's top and branches are reaching for the sky and Sun whereas its roots are stretching into the Earth's interiors.

The staged development of organic kingdom is just partly correlated with global climatic changes on the scale of geodynamic cycles as with changes in the atmosphere composition in cyclically intensifying volcanism. It may be explained by a considerable involvement of climatic and geochemical factors in the evolutionary component of phylogenesis. The component involves realignments merely in the adaptation of bioforms to changing ecological conditions and a selection of the most vital taxa.

Physical factors to control organic kingdom of the Earth are likewise recorded in a rank of geologically minor cycles (from minutes to tens and hundreds of years), being expressed in life rhythms at all systemic levels of biosphere (from micro-organisms to man). These rhythms are subordinated to cyclic variations of the solar activity, in particular (Chizhevsky, 1976). Rhythms of Sun and Earth's magnetic field govern all biological processes: from biochemical reactions in organisms to the development of their large communities or populations (Vladimirsky & Kislovsky, 1982; Shugrin & Obut, 1986). Biochemical processes may be controlled by the magnetic field due to a change in electric properties of aquatic physical-chemical systems of a cell and in permeability of its membranes (Dubrov, 1974). A structure of organisms may be controlled by that of the magnetic and gravitational fields, that is demonstrated by heliotropism and geotropism of plants that is their orientation to the Sun and the Earth's centre of gravity.

Different-level mutations proceeding when inversions and variations of cosmophysical and geophysical fields not only induce new taxa to appear but also make rhythms of physical fields to be fixed their genotype. This rhythmic becomes their own one, causing rhythmicity of biochemical processes, energetic and physiological in particular, and their large scale that is vitality. Interference of different-order biorhythms forms the stage-by-stage pattern of taxon life cycle. Therewith, taxon development is controlled by resultant physical-geodynamic variations which are resonantly superimposed on critical points of inborn biorhythms and provoke biochemical stresses and realignments in organisms, destructive for biotaxa included.

Biorhythms may be fixed in the spiral structure of deoxyribonucleic acid (DNA) being a central depository of heredity in the cell nucleus. The cyclic alternation of its four nucleotides forming 64 triplets and 20 amino acids forms an individually constructed sinusoidal molecular chain similar to the resultant sinusoid of biorhythms. Thus, the molecular structure of DNA combines all different-order biorhythms and is activated by fragments to direct certain biochemical processes in accordance with the related cosmophysical and geophysical rhythms. Inherited biorhythms are continuously corrected by outer rhythms during the synthesis (transcription) of informative and transport ribonucleic acids

(RNA) being responsible, in their turn, for the synthesis of proteins which are carriers of the organism phenotype. The phenotype thus presents individual heredity properties manifesting themselves depending upon current physical conditions and life cycle stages that is upon a level of the organism development. A limited adjustment of genotype, being possible provided that biorhythms are continuously externally physically corrected, ensures the reliable genetic code and evolutionary component of phylogenesis, showing a common physical nature of genotype and phenotype fixed, in turn, by the natural selection.

The biorhythmic complication of the molecular structure of genotype and its expression in the biophysical field of an organism explain the extreme difficulty to crossing dissimilar species formed under different geodynamic conditions and impressed them in their genotype. The species genotype is modified in nascent individuals, forming a scope of their mutual sexual preferences. The genotype becomes thus like individual score of the life symphony conducted by nature by means of cosmophysical and geophysical fields. After the sequential playing of all phenotypic variations of the score that forms the staged development and vitality fluctuations and individual, the natural death of the latter comes, which is accelerated by defects and anomalous nature of its genotype. Such an idea emphasizes an extra function of DNA as a biological clock counting a course of time by sequence of chemical reactions.

Life cycle of any taxon, lasting between similar geodynamic variations, beginning from a moment of taxon nascency is analogously limited. A current of its life is governed by a continuous synchronous adjustment of leading biorhythms to outer physical rhythms; the latter controlling life processes at key biosphere levels. The biochemical (energetic) taxon potential is most pronounced in the first semicycle of the geodynamic cycle akin to the taxon; the cycle corresponding to a wave of intensification of physical fields. This stimulates the taxon evolutionary rise and bloom with the maximum numbers and the wide distribution near the boundary of semicycles. A change-over of the akin geodynamic cycle into the second semicycle, with a direction inversion of physical fields and a new intensification, results in decelerating and decreasing amplitudes of biochemical processes and natural evolutionary decline that is aging and degradation of the taxon.

The taxon decline is accompanied by its decreasing reproduction, reducing living space and replacement by competition from the ecological niche.

A return of the akin geodynamic cycle into zero for the taxon phase whose parameters of physical fields due to megacyclic variations come outside the range of the resonant reaction of the taxon members, makes a further adjustment of their biorhythms to outer physical pulses be impossible. The growing desynchronization of physical and organism rhythms, abrupt especially at boundaries of geodynamic megaphases (Paleozoic and Mesozoic-Cenozoic) and geodynamic cycles (Caledonian, Herzynian and Alpine) leads to a disagreement of harmonic components of biorhythms and their general attenuation. Biorhythms seem to exist provided that they are resonantly externally stimulated, on the principle of pendulum motion, and their even partial desynchronization decreases energetics and vitality of the taxon. The abrupt decline of its vitality is aggravated by simultaneous catastrophic variations in habitat conditions: landscape, climatic, geochemical ones proceeding in critical points of geodynamic cycles.

Such a combination of outer and inner factors of phylogenesis results in the taxon extinction or re-nascency on termination its life cycle: the latter being subordinated to the most prominent physical cycle inversed prior to the taxon nascency. Taxonomic features of genotype form a range of the synchronous adjustment of biorhythms that is a level of the taxon ecological flexibility and hierarchic importance. At the same time, more fundamental and stable components of rhythmicity of cosmophysical and geophysical fields maintain as before the life of simpler organized bioforms and continuously correct (prevent from errors in reproducing) their genotypes.

Therefore, biosphere like any organism is a sensitive biophysical system adjusted to acoustic, electromagnetic, gravitational oscillations of the Earth that pulses, in its turn, with a rhythm of the Sun and Galaxy. The Earth's rhythmicity provide stable organization of the living whereas the Space rhythmicity stimulate its evolutionary variability, that supports panspermic theory merely in terms of the field organization of life.

The development of organic kingdom is often considered in the evolutionary or revolutionary respects, which certainly absolutize intervariable stages of the cyclic phylogenesis. Revolutionary transformations of

organic kingdom at inversions of cosmophysical and geophysical fields explain the sequentially complicating new bioforms and the intensively branching phylogenetic tree and divergence of new genetic features. The increasingly diversity of bioforms subjected to mutations is responsible for the avalanche-like acceleration of the biosphere development.

After the revolutionary epochs the following ecological adaptation of new taxa to similar habitat conditions characterizes, in turn, the evolutionary components of phylogenesis with an appearance of convergence elements of genetic properties and a parallel development of bioforms being at different steps of phylogenetic stairs. The convergence is realized at the expense of preservation of the most effective and universal organs of organisms at the natural selection in struggle of taxon for the existence and living space. The natural selection leans upon a fixation and improvement of genetic properties by the adaptation and learning or upon a suppression of these properties at their initial or appeared non-effectiveness. The perfection of such a mechanism of phylogenesis is supported by the mathematical resemblance of the organism adaptation degree to habitat condition and the second law of thermodynamics; the latter presenting a major theorem of the natural selection derived by R. Fisher and explaining in the physical respect the growing organization of biosphere (Kamshilov, 1974).

The first semicycle of the taxon life is characterized by its entirely manifested genomic possibilities owing to chromosome and gene mutations during the less important inversions and variations of cosmophysical and geophysical fields, which favour its adaptation to current variations of the natural environment. The progressive complication of taxon is supported by the increased vitality (energetics) of individuals and by their inner and outer competition fixing positive mutations by a learning- training of organs. The second semicycle of the taxon life shows, in its turn, regressive adaptation forms (extreme physiological and morphological complication) to prevail; they appear under conditions of the decreased vitality and unstable equilibrium between bioforms extremely adapted to certain habitat conditions and the unstable natural environment. The genomic potential of the taxon becomes by then exhausted, and mutations like gene recombinations in crossing individuals just intensify augment already useless or

regressive inherited properties. Such a nature of hologenesis shows that progressive genotype realignments provide equilibrium between the taxon and the world around whereas regressive ones augment their contradictions. Such a conclusion discloses equally the essence progress and regress concepts for animate and inanimate nature.

As inferred from the general layout of the organic kingdom development, the present-day treatments of Lamarkism and Darwinism (synthetic) evolution theories complement each other. Phylogenesis itself is governed by directed cosmophysical and geophysical mutations of organisms, indirectly manifested by biorhythmicity in their vitality and by the natural selection fixing vital transformations by means of adaptation and learning. Such a systemic concept of the naturally directed physical phylogenesis is also supported by a theory of nomogenesis inferred by L.S. Berg (1977). The theory is based upon facts of the parallel and convergent development of taxa and pre-adaptation that is the appearance of useful properties in organisms long before they are requested for the life-support.

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