THE CONCEPT OF EVOLUTION AFTER 150 YEARS SINCE THE PUBLICATION OF THE "ORIGIN OF SPECIES"

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Abstract. *Continuing the ideas of evolutionists (Georges-Louis Leclerc, Comte de Buffon) and of heredity theory (Jean Baptiste Lamarck), Charles Darwin succeeded in enriching causality phenomenon. He observed and demonstrated that all plant and animal species evolved along the time from common ancestors, under the pressure of the natural selection. His observations made in his journey around the world, of 57 months, allowed him not only the definition of the evolution theory but also of the movement of the Earth's mantle, of the coral reef barrier formation or of the volcanic islands. Basing on the palaeontological data, he established the gradual evolution of beings and not by a leaping one. After discovering of the genetic laws and especially after discovering the population genetics in 1920 it was demonstrated that the mutations do not transform species. They offer basic elements on which natural selection works. Within 1930-1940 anatomists, geneticitists, palaeontologists, ecologists and ethologists created the modern synthetic theory of evolutionism after which the new species appear due to the action of the natural selection on the gradual accumulations of mutations in isolated populations. After 1950, molecular genetic appeared, which studies the protean sequences and points out the gene importance in evolution. In 1977 the phylogenetic tree is redefined based on the genetic similarities and not only on the morphological features. Therefore by DNA sequencing and establishing molecular phylogenies, life tree includes three sections: Eubacteria, Archaea and Eukariota. By the sequencing of the human genome it was established that man and chimpanzee had a common ancestor. Synthesis led to the restriction of the numerous currents in the evolutional thinking and the concept of panselection appeared - as an acceptable evolutional mechanism in which macroevolution is considered only the result of the extensive microevolution. By the approaching of the cybernetic systems to those of the structuralist evolutionism the importance of the self-organisation processes revealed as factors which directed the evolution way. Today, for understanding the mechanism of the biological evolution history, Darwin's inferences are no more necessary; it has been read in the genetic code. DNA confirms the evolution reality and shows the level where mutations develop. The gene is recognized as the unit of selection.*

Keywords: *transmutation, evolution, Darwinism, neo-Lamarkism, Mendelism, evolutionary synthesis, panselection, structuralist evolutionism, sociobilogy, ultra-Darwinism.*

Rezumat. Conceptul de evoluţie la 150 ani de la publicarea originei speciilor. *Precedat de părintele evoluţionismului (Georges-Louis Leclerc, Comte de Buffon) şi de părintele teoriei eredităţii (Jean Baptiste Lamarck), Charles Darwin a mers la cauzalitatea fenomenului evolutiv. El a observat şi a demonstrat că toate speciile de plante şi animale au evoluat de-a lungul timpului din strămoşi comuni, sub influenţa selecţiei naturale. Observaţiile şi reflecţiile sale în călătoria în jurul lumii, timp de 57 de luni, la bordul navei Beagle i-au permis nu numai formularea teoriei evoluţioniste, ci şi a altor teorii, privind mişcarea scoarţei terestre, formarea recifelor-barieră şi atolilor de corali, formarea insulelor vulcanice etc. Pe baza datelor de paleontologie a constatat evoluţia graduală a vieţuitoarelor şi nu prin salturi. După descoperirea legilor geneticii şi mai ales după apariţia geneticii populaţiilor în 1920 s-a arătat că mutaţiile nu transformă speciile. Ele oferă materialele de bază (variaţiile) asupra cărora lucrează selecţia naturală, favorizând răspândirea celor favorabile, în toate populaţiile speciilor. În decada 1930-1940, anatomiştii, geneticienii, paleontologii, ecologii şi etologii au formulat teoria sintetică modernă a evoluţionismului, după care noile specii apar sub acţiunea selecţiei naturale, asupra acumulărilor gradate a mutaţiilor, în populaţii izolate. După anul 1950 a apărut genetica moleculară, care studiază secvenţele proteice şi pune bază pe importanţa genelor în evoluţie. În 1977 se redefineşte arborele filogenetic, pe baza similarităţilor genetice şi nu pe baza trăsăturilor morfologice. Astfel, prin secvenţierea ADN-ului şi stabilirea de filogenii moleculare, arborele vieţii cuprinde trei domenii: Bacteria, Archaea şi Eucariota. Prin secvenţierea genomului uman la început de secol XXI s-a stabilit că omul şi cimpanzeul au avut un strămoş comun. Sintezele au condus spre restrângerea numeroaselor curente din gândirea evoluţionistă şi a apărut conceptul de panselecţionism – drept mecanism evolutiv acceptabil, în care macroevoluţia este considerată doar rezultatul microevoluţiei extensive. Prin apropierea sistemelor cibernetice de cele ale evoluţionismului structuralist s-a dezvăluit importanţa proceselor de autoorganizare, ca factori care au direcţionat cursul evoluţiei. Astăzi, pentru a înţelege mecanismul istoriei evoluţiei biologice nu mai sunt necesare inferenţele lui Darwin (de altfel corecte), cu 150 de ani în urmă (ex., explicarea formei diferite a ciocului cintezelor din insule diferite în Galapagos), ci trebuie citită „scriptura" genetică. ADN-ul confirmă realitatea evoluţiei şi arată nivelul (genelor) la care se produc mutaţiile. Gena, mai curând decât întregul organism este unitatea asupra căreia acţionează selecţia.*

Cuvinte cheie: *transformism, evoluţie, darwinism, neo-lamarkism, mendelism, evoluţia sintetică, panselecţie, evoluţionism structuralist, sociobiologie, ultra-darwinism.*

Defining the base idea according to which the creatures evolve from a species to another and revising the entire title of the most important work published by Charles Darwin, 150 years ago (*On the Origin of Species by means of natural Selection, or Preservation of favoured races in the Struggle for Life*), we realise that the author was convinced that the better adapted descendants of a common ancestor will multiply and rule a territory, while the weaker ones have less chances to evolve in time, to a new species. After him, the species have a common ancestor and evolve, under the pressure of the natural selection, for surviving to the environmental conditions. The evolution is not the result of an inner tendency to perfection, but the result of a permanent contradiction between the tendency of the organisms of having a maximum reproduction and the limiting factors of the environment.

Even if the biological thinking was dominated by the fixity of creatures till the 18th century, yet the idea of their modification along time arose in humans' mind since the Antiquity. Greeks', Romans', Chineses', Muslims' ideas remained unanswered till the 17th century, when Galileo Galilei, father of modern physics and the discoverer of Venus (in 1610) laid the bases of the replacement of the geocentric theory, Ptolaemeus' legacy, with Isaac Newton's heliocentric theory (in 1687). After the new cosmological knowledge was spread, naturalists asked themselves on the species variability more and more. The birth of palaeontology pointed out the new concept of species disappearance and raised new questions on the static conception on nature. Thus we can distinguish a pre-evolutionary worldview.

At the beginning of the 19th century, Jean-Baptiste Lamark proposed the species transmutation/transformation theory (transformism) which later became the scientific theory of evolution. According to Lamark, the creatures did not have a common ancestor, and the simple life forms were always created by spontaneous generations. His theory marked first transmutationist ideas followed by principle of uniformity.

The term of evolution was used by Robert Jameson for the first time in pre-Darwinian evolutionary ideas (in 1826 - DESMOND, 1992), when he admired Lamark's theory, on how the larger beings "evolved" from the simplest worms. Those ideas played an important role in reform-minded a politically charged early in the 19th century in London. In 1844, the Robert Chambers published the book *Vestiges of the Natural History of Creation*, proposing an evolutional scenario, as a progressive process of the origin of the solar system and of life on Earth. Fossils indicated the progressive growth of the animal kingdom, relatives of the extinct species among the present ones and the evolutional line which led to Hominidae. Cuvier contradicted Lamark's idea and of the anatomist Étienne Geoffrroy de Saint-Hilaire, supporting Aristotle's conception according to which the species were immutable. Louis Agassiz and Richard Owen, and the geologists Charles Lyell were fixity partisans and anti-Lamark, eliminating the idea of the species transformations for decades.

BOTNARIUC (1992, page 34) mentioned that evolution concept was introduced by SPENCER (1864-1867) meaning the phylogenetic development but today the term is very complexly used: evolution of a disease, evolution stars, of a football match, of a political situation, social evolution etc.

In 1859, Charles Darwin published *On the Origin of Species, or the Preservation of favoured races in the Struggle for Life*, basing on the ideas of natural selection theory, on the conclusions of the synthetic study of the complex collections present in his time and, especially, on the study of his own collections, gathered along 57 months (1831-1836), the period when he travelled at the board of the ship "Beagle". Biogeographical, geological data (from which he understood that the Earth changed in time), then the palaeontological, anatomical, embryological data made him to understand that the creatures had a common ancestor, from which the phylogenetic tree resulted. This theory was convincing for most of the biologists, which, in their turn, understood the presence of the biological evolution, but they were not convinced that the natural selection was its primary mechanism.

Among the fundamental ideas of the evolutionist theory distinguishes the gradual transformation of the species (some of them evolving from others), by the variability interaction, heredity, overpopulation, fight for surviving and natural selection. Variability, as a result of the correlation between organism and environment, offers material for the selection activity. Even if he was inconsistent, since then Darwin admitted heredity of the given features, heredity having to fix variations and to gather them along generations. Natural selection had to stimulate the development of the well adapted forms, by which the adaptive features improve from a generation to another.

Also, HUXLEY (1868) was not totally convinced by the key role of the natural selection; he was not convinced by the gradualism invoked by Darwin, too. But, he was a well known English anatomist and he was the first who understood that birds descended from carnivorous dinosaurs. He did not adopt Darwin's ideas but in 1860 he became an enthusiastic supporter of the evolutionist theory, reason why he was called "Darwin's bulldog". He recognized and publicly asserted that, in comparison with Lamark's transformism, Darwin's theory explained the evolution mechanism without the intervention of a supernatural force.

DARWIN (1859) not knowing yet about heredity wrote: "*…As many more individuals are produced than can possibly survive, there must in every case be a struggle for existence, either one individual with another of the same species, or with the individuals of distinct species, or with the physical conditions of life…. Can it, then, be thought improbable, seeing that variations useful to man have undoubtedly occurred, that other variations, useful in some way to each being in the great and complex battle of life, should sometimes occur in the course of thousands of generations? If such do occur, can we doubt (remembering that many more individuals are born than can possibly survive) that individuals having any advantage, however slight, over others, would have the best chance of surviving and of procreating their kind? On the other hand, we may feel sure that any variation in the least degree injurious would be rigidly destroyed. This preservation of favourable variations and the rejection of injurious variations, I call Natural Selection*." His argument was that natural selection emerges as a necessary conclusion from two premises: a) - the assumption that hereditary variations useful to organisms occur; b) - the observation that more individuals are produced than can possibly survive. The most serious difficulty facing Darwin's evolutionary theory was the lack of an adequate theory of inheritance that would account for the preservation through the generations of the variations on which natural selection was supposed to act. Theories then current of "blending inheritance" proposed that offspring merely struck an average between the characteristics of their parents.

In his letter to J. D. Hooker, in 1869, Darwin himself wrote: "*If I live another 20 years and I am able to work, how much I should modify the SPECIES ORIGIN and how much I should modify my perspective on all ideas! Yet, this is a beginning and this means something …*"

HUXLEY (1868) contributed to the foundation of Darwinism followed by the eclipse of this theory between 1875 and 1925.

Most of the naturalists, named neo-Lamarkians, explained the evolution by the inheritance of the given features, an inborn tendency of progressive change (orthogenesis) or by sudden mutations (evolution by leaps).

After Mendel's studies (1866) about the inheritance, his work contributed to the foundation of the modern science of genetics and mutation theory. Even first rejected, Mendel's ideas were rediscovered in the early of the 20th century and in 1930 and 1940 the modern synthesis combined Mendelian genetics with Darwin's theory of natural selection. This was based on the new field opened by the genetic laws elaborated by Gregor Mendel – population genetics which appeared in 1920 and in 1930. Later, population genetics was included in other branches of biology and the synthetic theory of evolution resulted.

Following the laws of the biologic evolution, studying the mutations and variations of natural population, combined with the biogeographical and systematic data, a complicated mathematic and causal pattern of evolution was created. Palaeontology and comparative anatomy permitted the detailed reconstruction of life history. After 1950, molecular genetics appeared, which developed the molecular evolution, basing on the protean sequences and on immunologic tests, then including the studies on RNA and DNA. The conception based on the importance of genes in evolution reached its apogee in 1960, and it was followed by the theory of the molecular evolution, raising passionate discussions on adaptations, selection units and the relative importance of the genetic drift in comparison with the natural selection. At the end of the 20th century, DNA sequence permitted the establishing of molecular phylogenesis and the reorganization of life tree in three fields: Bacteria, Archaea and Eukariota. In addition, the newly recognized factors of the symbiogenesis and of the horizontal transfer of genes made the evolutionism history much complicated.

That is why, in the 20th century, there were several naturalists who considered the Lamarkian mechanisms of the orthogenetic evolution offered the best explanations on the complexity of the present living world. Just the genetics development and the genetic diversity emphasized by the Russian specialist CHETVERIKOV (1927) and by DOBZANSKY (1937) diminished the supporting of Lamarkism and founded the development of micro-and macroevolution.

In his work, MAYR (1942) took into account the German specialist Bernhard Rensch's papers, on the influence of the environmental local factors on the species distribution and on closely related species. This kind of speciation occur within the conditions of the geographical isolation of a subpopulation, accompanied by the mechanism developing of the of reproduction isolation. Mayr (op. cit.) laid the foundation of the biological species concept – as a population group with compatible or potentially compatible individuals to breed and which is isolated from other populations, from the reproductive point of view.

SIMPSON (1944) demonstrated that the fossil study did not indicate a directional pattern of evolution and that the linear tendencies, supported by the palaeontologists and by neo-Lamarkians, were repealed by the subsequent specialized studies. Simpson (op. cit.) integrated the facts of palaeontology with those of genetics and natural selection.

Synthetic theory of evolution provided the conceptual principle of natural selection and of population genetics (belonging to Mendel), which, in fact, includes all biological fields. This theory offered legitimacy to the evolutionist biology and allowed a scientific climate, which promoted the experimental methods instead of those of science history. Syntheses led to the restriction of the numerous currents of the evolutionist thinking, phenomenon which GOULD (1977) called "*strengthening of syntheses*", according to which natural selection actions on the genetic variation, generating the new concept of "*panselectionism*" – an acceptable evolutional mechanism, in which the macroevolution is considered only the result of the extensive microevolution. The concept of synthetic theory was invented and used by HUXLEY (1942), in his book "*Evolution: the modern synthesis"* and represents the present paradigm of the evolutionist biology. By this concept the difficulties and the confusions, appeared because of the strict specialization of some specialists and the lack of communication between the biologists of the first half of the 20th century, were solved. Huxley's modern synthesis gathered ideas of different branches of biology: genetics, cytology, systematics, botany, morphology, ecology, palaeontology.

After the appearance of molecular biology, at the half of the 20th century, the chemical nature of genes as DNA sequences and their relations with the protean sequences was better understood by the genetic code. Meanwhile, the biochemical phenomena were also included in the synthetic theory of evolution due to the huge development of the analyzing technics of proteins (electrophoresis, sequencing). ZUCKERKANDL & PAULING (1962) proposed the hypothesis of the "*molecular clock*", according to which the differences of the sequences from the homologous proteins can be used in calculating the time difference between two divergent species. KIMURA (1969, 1983) and CROW (1972) demonstrated that, at least at the molecular level, most of the genetic mutations are neither injurious nor useful, and the genetic drift is responsible for a large part of the genetic exchange (according to them, more than the natural selection). This conception (obviously non-Darwinian) got the name of neutralist theory of the molecular evolution. The studies on the intraspecific protean differences also provided molecular information on the population genetics, by the estimation of the heterozygosity level in natural populations.

BORNARIUC (1992) mentioned that neo-Darwinians reject the neutralist theory, because they consider high genetic polymorphism as an advantage in the natural populations and the selection used different mechanism to determine a high genetic variation in populations.

Thus, after the '60s, molecular biology was received as a threat to the traditional content of the evolutionist biology. The three architects of the modern theory (the synthetic one of evolution), Ernst Mayr, Theodosius Dobzhansky and G. G. Simpson (all Darwinists) were extremely skeptical with the molecular approach, especially when it referred to the new content of natural selection or even ignored it. Hypotheses of the "*molecular clock*" (species detachment from a common ancestor based on the differences of the protean structure or DNA) and the neutralist theory of evolution were passionately discussed, invoking the relative importance of the genetic drift, but also of natural selection, debates which also continued in the '80s, practically without clear conclusions from neutralists and selectionists.

Also, after the '60s, George C. Williams severely criticized the term of adaptation with the sense of "species surviving", as an argument of the group of the "selectionist" specialists. The explanations on the adaptation and species surviving were replaced by a new concept on evolution which focused on gene. It reduced itself to the similar arguments of selection, introduced by W. D. Hamilton, George R. Price and John Manyard Smith, resumed by DAWKINS (1976) in his book "*The Selfish Gene*". But, those evolution patterns were too limited and did not allow the explanation of selection at different organization levels of the living matter. By applying the concept of the selfish gene to the origin of social instincts, the new Darwinism opened up a revolutionary approach which became known as socio-biology and ultra-Darwinism which recognize the gene as the unit of selection.

VAN VALEN (1973) proposed the term "*Red Queen*" for describing a scenario according to which an implied species in one or several evolutional directions should change continuously in order to be in harmony with the co-evolutional species.

Hamilton, Williams and others suggested that this idea can explain the evolution of the sexed reproduction, in which the growth of the genetic diversity determined by the sexed reproduction might help the resistance against the rapid evolution of parasites. Thus, in spite of the huge cost from the point of view of the central importance of gene, only half of an organism genome can transfer by the sexed reproduction. The supporting of the central part of gene within the evolution process brought to light again the importance of Darwin's idea on sexual selection and lately, the theme of the sexual conflict and of the intragenomic conflict.

Studying different kinds of selection, HAMILTON (1964) created a new discipline – sociobiology, which presumed the presence of the altruistic habits, a dilemma of the evolutionary theorists, since the 19th century. Hamilton (op. cit.) demonstrated the inequality of the selection ways, giving example the social organization in insects (with sterile workers). WILSON (1975) published the book "Sociobiology: New Synthesis", in which he supported that the evolutionist theory can explain many aspects of the animal world, including human habits. The critics of the "new synthesis" (GOULD & LEWONTIN, 1970) considered that sociobiology exaggerated the degree in which the complex human habits can be influenced by genetic factors. They also supported that the sociobiologists' theories seldom reflect their ideological conceptions. But, in spite of these critics, papers continued both in sociobiology field and in related fields of evolutionist psychology, including also other aspects of altruism.

After '70s, serious debates on the punctual equilibrium theory appeared. Niels Eldredge and Stephen Jay GOULD (1972) considered that in the existence of the fossil species there was a pattern which, broadly remained unchanged (*stasis*) for a very long period of time, scattered with short periods of rapid changes within the speciation duration. This is a sending to the intermittent equilibrium theory (ELDREDGE, 1972), after which the evolutional process (appearance of new taxa) manifest once in a while, alternating with long periods of relative stability/equilibrium. He criticized the supporting of the central role of gene within biological evolution and pointed out the importance of the evolutional and ecological systems.

The improving of the sequence technics of DNA and the growth of the sequential genomes permitted the testing and redefining the evolutionist theories, basing on the information on genome. The comparisons between these genomes permitted the understanding of the deep molecular mechanism of the speciation and adaptation. Genomic analyses generated fundamental changes in the understanding of the evolutional history of life, as the creation of the system with three fields (Bacteria, Archaea and Eukariota) made by WOESE (2000, 2001, 2002, 2004). The improvement of the informational technics (hard and soft) permitted tests and extrapolation of the advanced evolutional patterns and the development of the field of the biological systems. One of the results was the exchange of ideas between the biological evolution theories and the data processing fields, known as computerized evolution, which tries to simulate the biological evolution for the developing of the new computerized algorithms. Present discoveries of biotechnology allow the genome modifications, leading the evolutional studies up to the level in which the future experiments will be implied in the creation of synthetic complex organisms.

Because of the lack of some clear morphological features and of a concept on species in microbiology, this field was neglected by the evolutionist theory. Today, by the comparison of the microbial genomes, amazing progresses in the understanding of the physiology and ecology of these organisms were made and their taxonomy and evolution could be explored. Such kind of studies pointed out unthinkable levels of the microbe diversity and demonstrated that they represent the prevalent form of life on Earth.

A very important result of the study of the microbial evolution was the discovering of the horizontal transfer of genes, in Japan, in 1959. This transfer of genetic material between different bacterial species played an important party in the resistance spread against antibiotics. Then, continuing the study and the understanding of genomes it was suggested that the lateral transfer of genetic material was very important in the evolution of all organisms. As a part of the endosimbiotic theory for the origin of organs, horizontal gene transfer was a critical moment in the evolution of eukaryots: fungi, plants and animals.

In 1980 and 1990, the principles of the modern evolutionist theory (synthetic) were minutely investigated and the themes of the structuralist evolutionist biology (GOODWIN, 1994, KAUFFMAN, 1993) were resumed. Goodwin comes to the conclusion that biological complexity has arisen through the ordering of dynamic systems independently of the action of genes. The ideas of cybernetics were put together with those of the theory of systems and it was underlined the importance of the development of the self-organization processes, as factors which directed the evolution course. Evolutionist biologist Stephen Jay Gould updated the older ideas of the heterochrony – alternations in the relative rhythm of the developing processes during evolution course, explaining the new forms of generations. GOULD & LEWOTIN (1970) published a paper in which they suggested that a change in any biological structure or even a structural novelty can appear incidentally as an accidental result of selection on another structure, most probable than by the direct selection for a certain adaptation. These incidental structural changes were named "*sprandeli*", after the architectural term – the space between the arches bases in constructions. Then, GOULD & VRBA (1982) brought under discussion the acquisition of some new functions of the new structures, appeared this way, and named "*exaptations*".

Molecular data underlined that the development of the animal morphology was not the result of different kits of regulator proteins of the development of different animals but the changes of the development of a small kit of proteins, which were common to all animals. These proteins were known as "kits of developing". From this perspective, phylogeny, palaeontology and the biology of comparative development were influenced later, generating a new discipline – "*evo-devo*".

Recently, the papers of this field pointed out the phenotypical and developing plasticity. Rapid appearance of the base plans in the structuration of the animal bodies from the Cambrian "explosion" was mostly due to the environmental changes which action on the properties of the inborn material of the cellular colonies, by the differentiate adhesion of cells and by biochemical oscillations. Resulted forms were later stabilized by natural selection. Experimental and theoretical studies on these and other related ideas were gathered in a volume, "The Origin of Organism forms", signed by several authors.

Among the non-conventional evolutionist theories we mention Pierre Teilhard de Chardin's "omega point": (unscientific), according to which the gradual development of the Universe, from the level of the subatomic particles to human society, would be the final stage and purpose – ideas linked by James Lovelock's Gaya theory, which proposed that the living and non-living parts of the Earth to be considered a complex systems of interactions, similar to the organ systems with all types of tissues which make a living organism. Considered an extension of the endosimbiosis and exosimbiosis, this hypothesis establishes that all creatures have a regulator effect on the Earth environment which spreads life everywhere. Futurists see in the scientific and technologic progress a continuation of the biologic evolution, technologic evolution being the purpose of their philosophy.

Starting with a pre-evolutionary worldview, in 1809 there appeared first transmutationists followed by foundation of Darwinism. The period between 1875 and 1925 can be considered the eclipse of Darwinism and defence of neo-Lamarkism. Mendelism and mutation theory preceded the evolutionary synthesis theory. In the last decades, socio-biology and ultra-Darwinism debate how natural selection operates as a crucial mechanism in evolution. Ultra-Darwinism focused on the gene recognizing that these (rather than the whole organism) could be treated as the unit of selection.

Today, after 150 years since the printing of Charles Darwin's masterpiece, the biological evolution is considered by most biologists as a result of the natural selection, by the action of the environmental factors on some populations of creatures in competition for getting resources, necessary to surviving and reproduction. In other words, in the evolutionary race, each species has to improve itself constantly or it will be outstripped by its rivals.

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