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Biological & Social Phases of Big History: Similarities & Differences

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Big History approach regards *the process of evolution* as a continuous and unified process from the origins of the Universe until the present state of humankind. Cosmic, geological, biological, and social phases of Universal evolution have a genetic and structural continuity.

Figure. Big History Phases

In the paper we are presenting our analysis of similarities and differences between two phases of Big History (= two types of macroevolution): biological and social ones.

Comparison between different phases of Big History is especially important, because such an analysis suggests new promising possibilities to deepen our understanding of the course, trends, mechanisms and peculiarities of different phases of Big History.

Connections between Phases of BH

Each subsequent phase of Big History is accompanied by the emergence of new evolutionary mechanisms. Also:

- certain prerequisites and respective preadaptations can be normally detected within the previous phase;
- emergence of new evolutionary mechanisms does not imply the invalidation of those ones active during the previous phases;

Connections between Phases of BH

- one can observe the emergence of a complex system of interaction between various forces and mechanisms determining the evolution of new forms. For example, biological organisms operate in the framework of certain physical, chemical and geological laws; behavior of social systems and people has certain biological limitations and so on.

Connections between Phases of BH

Some models (similar in principle) may emerge not only in the breakthrough points, changing the main line of evolution, but also in some directions that may be regarded as deadends, from the Big History leading line perspective. For example, the emergence of social life forms took place in many phyla and classes – from bacteria to insects, birds and mammals. Additionally, among insects, we can find rather high forms of socialization.

The Most Important Similarities between Two Types of Macroevolution

The most important similarities between biological and social types of macroevolution *stem from the following points*:

• In both cases we are dealing with very complex non-equilibrium (but rather stable) systems whose principles of functioning and evolution are described by the General Systems' Theory.

The Most Important Similarities between Two Types of Macroevolution

- In both cases we are dealing with a complex interaction between systems and external environment, whereas the reaction of systems to external challenges can be described in terms of certain general principles.
- There is a direct ‘genetic’ link between the two types of macroevolution and their mutual influence. So in certain respects it appears reasonable to consider the biological and social macroevolution as a single macroevolutionary process.

Similarities in some processes of two BH phases

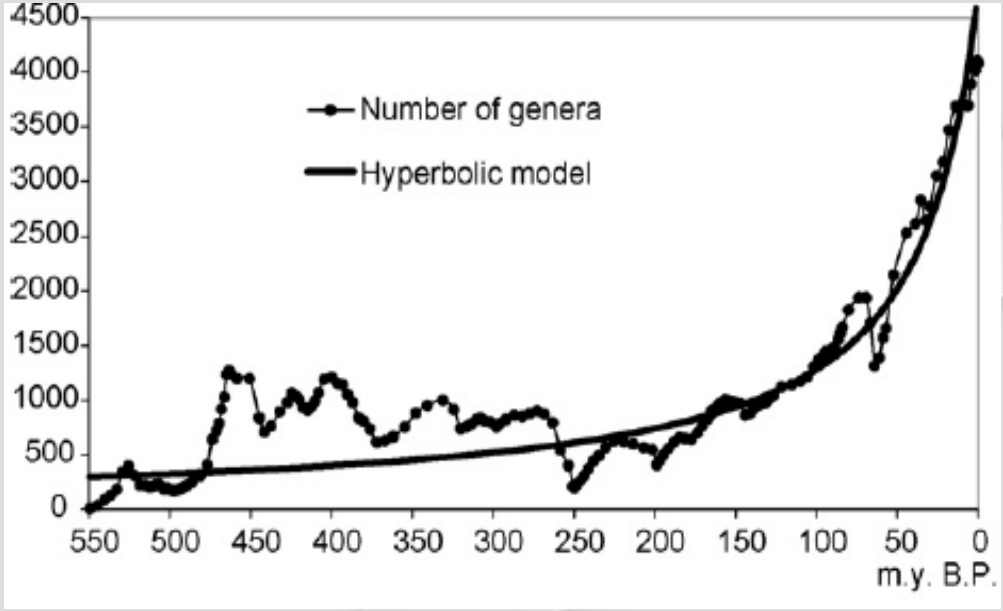
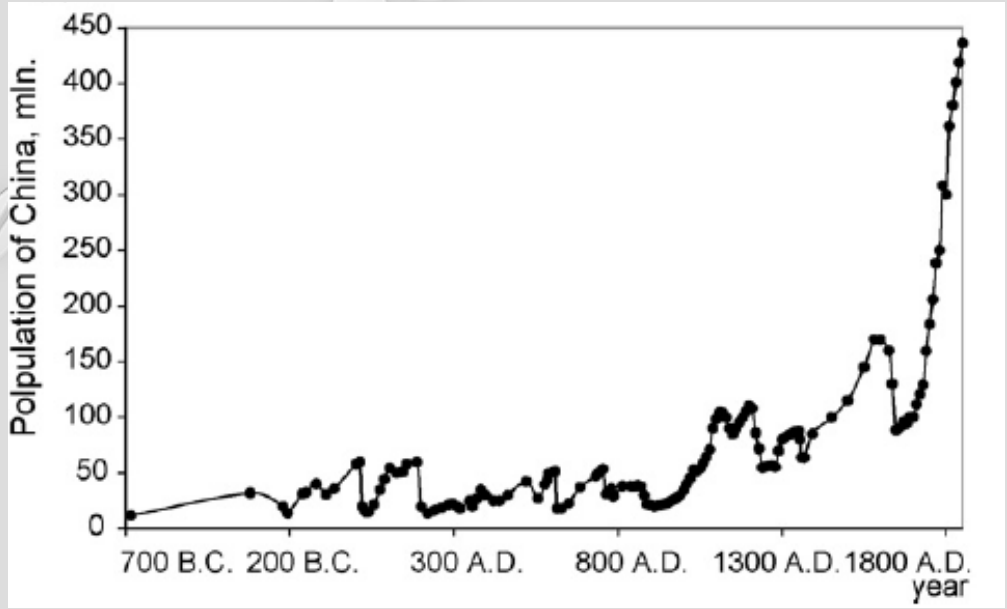


Diagram 1.
Global change in marine biodiversity (number of geenera, *N*) through the Phanerozoic

Diagram 2.
Population Dynamics of China, mlns, 700 BCE – 1850 CE



The Most Fundamental Differences between Two Types of Macroevolution

Biological evolution is more additive (cumulative) than substitutive; put it another way: ‘the new is added to the old’. The development of biological changes tends to contribute to the increase in biodiversity (while new taxa evolve, the old ones do not necessarily disappear).

In contrast, *social evolution* is more substitutive than additive; put it another way: ‘the new replaces the old’.

The Most Fundamental Differences between Two Types of Macroevolution

The diffusion of *social changes* tends to replace more simple social forms with more complex ones. New technologies supersede the out-dated one.

Thus, with the diffusion of iron technologies all the societies that confronted this diffusion had to borrow this technology, otherwise they risked to be absorbed or destroyed by those societies that possessed this technology.

Some Other Differences between Two Types of Macroevolution (by Hallpike)

1. Societies are capable of such rapid evolutionary metamorphoses that they were not observed in the pre-human organic world.
2. They may be also transformed consciously and with a certain purpose. Such characteristics are absent in natural biological evolution in any form.
3. In the process of social evolution the same social organism may experience radical transformation more than once.

Some Other Differences between Two Types of Macroevolution (by Hallpike)

4. Key information transmission differs significantly in biological and social evolution.
5. In biological evolution, acquired characteristics are not inherited; thus, they do no not influence the biological evolution that proceeds very slowly.
6. The biological organism does not evolve by itself; evolution may only take place at a higher level (population, species, *etc.*), whereas social evolution can often well be traced at the level of an individual social organism.

Exchange of Information: Differences and Similarities

Social systems have the ability to not just change and transform, but also to borrow new elements. It is considered that is not observed among biological system.

However, it is right not for all levels of *biological evolution*. This concerns, first of all, the more complex biological organisms.

At the same time among the simplest forms of life – microorganisms – such interesting information transmission mechanism as the horizontal exchange of genetic information (genes) exists.

The horizontal exchange of genetic information is any process in which an organism incorporates genetic material from another organism without being the offspring of that organism.

The horizontal exchange of genetic information makes many useful genetic ‘inventions’ literally a sort of ‘commons’ of microbe communities. Among the bacteria, the horizontal transmission of genes contributes to the fast development of antibiotic resistance.

The horizontal exchange of genetic information (in the principle of its function) is distantly similar to those forms of information exchange that became extremely important within *social evolution* – the direct borrowing of innovations and their introduction into social life. Hence, the principles and mechanisms that appear marginal at a certain Big History phase may turn out to be extremely important at another phase.

The Horizontal Exchange of Genetic Information

Thus, in the *biological macroevolution* the 'borrowing' is found mostly at lower levels, whereas it is found much less frequently at higher levels.

The opposite situation is observed in *social macroevolution* – in general, the less developed the society, the lower its borrowing rate. This accounts to a considerable extent for a low rate of change in the majority of archaic simple social systems.

The Necessity to Comprehend the General Laws and Regularities

Thus there are manifold similarities and differences between two types of macroevolution. This implies the necessity to comprehend the general laws and regularities that describe this process, though their manifestations may display significant variations depending on properties of a concrete evolving entity (biological, or social one).

Aromorphosis

An important concept possibly contributing to the improvement of the operational comparison between these two types of macroevolution is to use the term *aromorphosis*. There is such a term in the biological macroevolution studies. This concept is well established within Russian evolutionary biology.

The process of aromorphosis formation is called *arogenesis* that is rather close to *anagenesis* in the sense in which this term was originally proposed by Rensch.

Several definitions of the aromorphosis have been proposed, for example:

1. '*Aromorphosis is an expansion of living conditions connected with an increase in complexity of organization and vital functions*' (Shmal'gauzen).

2. '*Aromorphosis is an increase in the organization level that makes it possible for aromorphic organisms to exist in more diverse environments in comparison with their ancestors; this makes it possible for an aromorphic taxon to expand its adaptive zone*' (Severtsov A. S.).

Among classical examples of major biological aromorphoses one could mention:

- the emergence of the eukaryotic cell,
- the transition from unicellular organisms to multicellular ones (that took place more than once in many lines of unicellular eukaryotic organisms),
- the transition of plants, arthropoda, and vertebrates to life on dry land,
- origins of mammals from theriodonts,
- origins of *Homo sapiens sapiens* etc.

We propose to expand the concept ‘aromorphosis’ onto the social macroevolution. The term ‘social aromorphosis’ was developed by us as a counterpart to the notion of biological aromorphosis. We regard *social aromorphosis* as a rare qualitative macro-change, which leads to a very significant increase in complexity, adaptability, and mutual influence of social systems, thus opening up new possibilities for social macro-development.

The social aromorphosis can be defined as a universal / widely diffused social innovation that raises social systems' complexity, adaptability, integrity, and interconnectedness.

Social aromorphoses lead to the following results:

a) more rapid developmentary changes (including borrowings) that do not destroy social system;

b) the increase in the degree of intersocietal integration, formation of special stable supersystems (civilizations, various alliances etc.) and suprasocietal zones, special suprasocietal spheres that do not belong to any particular society;

Examples of Social Aromorphoses of the Highest Type:

- Transition to food production that led to an immense artificial increase in the quantities of useful (for humans) biomass;
- State formation that led to a qualitative transformation of all social, ethnic and political processes;
- Invention of writing that served as a basis for the revolution in information;
- Transition to iron metallurgy;
- Invention of computer technologies.

We have identified a number of rules and laws most tightly connected to arogenic evolution which can be divided into three groups:

- rules connected to the characteristics of the aromorphosis formation and distribution mechanisms;
- rules connected to the pace and rythm of macroevolution;
- rules connected to the direction of macroevolution.

Some Important Rules from the First Group

The rule of aromorphic ‘relay-race’ demonstrates that the chain of major aromorphoses appears due to continuity of different taxa and societies with relatively complex trajectory of development. This development does not follow a straight line, but has, speaking conventionally, constant fluctuations, rollbacks, zigzags, which results in retrospect in the formation of arogenic ‘relay-race’ trajectory. Such complex ‘relay-race’ evolutional trajectory may well be designate as an arogenic line of evolution.

Some Important Rules from the First Group

Law of the evolutionary 'block assemblage'

When a system reaches a certain level of sophistication and maturity, it may start to be used as a whole within the process of evolution (as a single unit, a single block). In the process of adaptations and specialization, this block experiences an adjustment for the needs of a particular (biological or social) organism.

Some Important Rules from the First Group

The rule of 'payment' for the aromorphic progress

The emergence of major aromorphoses takes place against the background of extinctions and unsuccessful evolutionary 'attempts' of many species (societies) and groups. In particular, many groups disappeared in the process of transition from one adaptive zone to another. Evolutionary breakthrough to the qualitatively new level (aramorphosis) in one place (society) over almost all the period of human history, could take place only at the expense of assimilation, stagnation, moving aside etc. of many other societies.

Thanck you for attention!