

Is Evolution a Causal, Yet Not-Predetermined Process?

Maria K. Koleva

Institute of Catalysis, Bulgarian Academy of Sciences, Sofia, Bulgaria

Email: mkoleva_1113@yahoo.com

How to cite this paper: Koleva, M.K. (2022) Is Evolution a Causal, Yet Not-Predetermined Process? *Journal of Modern Physics*, 13, 707-721.

<https://doi.org/10.4236/jmp.2022.135040>

Received: March 15, 2022

Accepted: May 17, 2022

Published: May 20, 2022

Copyright © 2022 by author(s) and Scientific Research Publishing Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

It is demonstrated that “survival of the fittest” approach suffers fundamental flaw planted in its very goal: reaching a uniform state starting from a minor random event. Simple considerations prove that a generic property of any such state is its global instability. That is why a new approach to the evolution is put forward. It conjectures equilibrium for systems put in an ever-changing environment. The importance of this issue lies in the view that an ever-changing environment is much closer to the natural environment where the biological species live in. The major goal of the present paper is to demonstrate that a specific form of dynamical equilibrium among certain mutations is established in each and every stable in a long-run system. Major result of our considerations is that neither mutation nor either kind dominates forever because a temporary dynamical equilibrium is replaced with another one in the time course. It will be demonstrated that the evolution of those pieces of equilibrium is causal, yet not predetermined process.

Keywords

Stable Evolution, Survival of the Fittest, Causality, Central Limit Theorem, Decomposition Theorem, Markov Process

1. Introduction

Despite great efforts undertaken recently, the issue about the general properties of evolution of eco-systems is far from establishing decisive solution. So far the dominant concept is based on the understanding that the most successful adaptations commence as a specific selection of random mutations that goes permanently among a given population and whose ultimate goal is spreading throughout the entire population. Put in other words, this approach, popular as “survival of the fittest”, asserts that a non-causal individual (random in its origin) reason has

a long-term causal effect on the entire population. Further, the so established novel traits and features are open to novel type random mutations some of which again spread throughout the entire population and so on. However, since this scenario works for each and every kind of biological species and since the rate and intensity of those adaptations vary from one kind to another, most likely this scenario renders the corresponding eco-system permanently out of balance.

The quantification of the above scenario happens through the basic approach called fitness landscapes. The approach explores the major ideas of chaos theory, namely the sensitivity to initial conditions and the butterfly effect for achieving the goal about spreading of a local mutation throughout a system. All mutations are considered local and random in origin. The central point is assigning of a specific probability for survival, called fitness, to each and every mutation. Then, each fitness is currently modified under specific dynamical rules and novel values are assigned according to them. The ultimate goal is reaching a stationary state where a single constant fitness is established throughout the entire system. The parallel with the above mentioned suppositions of chaos theory is seen in the following: 1) the sensitivity to initial conditions is presented through permanent modifications of each local fitness; 2) the butterfly effect is substantiated through the ultimate goal, namely establishing a single steady cooperative state throughout the entire system starting from a small local random event.

One of the major flaws of the above approach is that the desired cooperative state is static not dynamical. The fundamental difference between the latter is that a static equilibrium implies that, on arrival at it, a system stays there forever while a dynamical equilibrium implies long-run balance between participating interactions. Indeed, as an immediate consequence of chaos theory, no dynamical correlations are established. This suggestion is supported by the fact that the power spectrum of each and every chaotic time series is white noise. The latter implies that there are no steady correlations among the power spectrum components. Thus, the ultimate steady state is uniform with regard to the victorious mutation.

Further, to the most surprise, the dominance of a single mutation over all others not only does not increase the strength of the corresponding system, but on the contrary, it weakens its stability by means of making the system vulnerable to a larger variety of hazardous events. To remind, the exclusive property of mutations is that each of them exerts specific robustness to a given environment. This issue is especially acute for systems put in an ever-changing environment. It is obvious that then, a single mutation is “fittest” only temporary: at the next instant another mutation turns more advantageous.

It is worth noting also that there is another cause for vulnerability of established uniform state: in general, all physical interactions between species in media, are short-ranged. Then, with a lack of long-range interactions, any uniform state is globally unstable, because any tiny local perturbation rapidly develops into a global one by means of excitation of the longest wave-length modes.

Then, the question becomes whether establishing of any form of equilibrium is ever possible for systems put in an ever-changing environment? The importance of this issue lies in the view that an ever-changing environment is much closer to the natural environment where the biological species live in. The major goal of the present paper is to demonstrate that a specific form of dynamical equilibrium among certain mutations is established in each and every stable in a long-run system. The generic characteristics of intra-kind and inter-kind dynamical equilibrium are subject of the present paper.

The major result of our considerations is that neither mutation nor either kind dominates forever because a temporary dynamical equilibrium is replaced with another one in the time course. It will be demonstrated that the evolution of those pieces of equilibrium is causal, yet not predetermined process.

Let us start with modeling of an ever-changing environment: we consider its major property to be diversification of impacts and responses, *i.e.* each of its components acts on different part of a system., e.g. sound acts on our hearing while heat on our skin. This renders mutations not only specific but diversified and qualitatively different. In turn, the latter renders all the probabilistic approaches inappropriate for the modelling the behavior of the corresponding system. This is so because the grounding idea of all probabilistic approaches is assigning a single number (current probability) to any variable, thus smearing out the qualitative difference among events (hearing and heat sensors in the skin in the above example). Even when a boundary separating qualitatively different events is established, it is quantitative and so does not allow emergence of a new quality.

This problem is so serious that its successful solution calls for fundamentally novel approach. The grounds for novel modelling is substantiated though the recently put forward by the author concept of boundedness [1]. It consists of the idea that a complex system put in an ever-changing environment operates steadily in a long run if and only if the rates and amplitudes of exchanging energy/matter/information never exceed specific margins. The exclusive property of that approach is the existence of a dynamical equilibrium for each and every system subject to boundedness. This is an immediate consequence of the central result of the concept of boundedness, proven by the author [1] [2]. It states that a dynamical equilibrium indeed comprises a specific steady pattern whose major generic property is that it is robust to the details of corresponding interactions. Rigorously speaking, the proven theorem, called by the author decomposition theorem, asserts that the power spectrum of each and every bounded irregular sequence (BIS) comprises additively two bands: 1) a specific discrete one, the position and intensity of whose components are robust to the details of the concrete interactions and to the minor variations of the environment; 2) a continuous band, the shape of whose envelope is also robust to the details of the concrete interactions and to the minor variations of the environment. The specific steady pattern is called by the author a homeostatic pattern. It is important to stress that it stands as an exclusive characteristic of a kind. It is obvious that the

homeostatic pattern of a single kind put in an ever-changing environment stays the same as long as the homeostatic pattern of the environment stays intact.

Next question asks whether inter-kind equilibrium is a generic property for every eco-system or its establishing needs meeting of additional constraints. The answer to this question is that establishing of an inter-kind equilibrium is not always available; it is available only for those eco-systems which are subject to the so called protocol of compatibility.

A general prerequisite of such protocol commences from the idea about hierarchical structuring of complex systems. It asserts that each and every complex system is hierarchically organized so that each and every hierarchical layer responds with bounded intensity to specific stimuli. The gain of such distribution of impacts is three-fold: 1) it strengthens the overall response; 2) it increases the types of stimuli to which a system respond in a controlled way; 3) it keeps the damages local as long as possible. The latter will become clear through considerations in Section 3. An exclusive for this type of hierarchy property is that the boundedness of the response renders the decomposition theorem to hold at each and every hierarchical level. Then the environment to a given hierarchical level comes from all other levels. Yet, the pre-dominant influence comes from the nearest lower level and higher level.

The evolution of an eco-system subject to that general protocol is driven by the perpetual motion in the state space sustained by means of orchestrating the directions of the development of the corresponding homeostatic patterns. It operates by means of two major implements: 1) the boundedness keep each and every homeostasis intact to the details of environment as long as the latter do not change it. 2) only changes in homeostasis of any current environment could provoke changes in homeostasis of the current hierarchical level; The far going consequence of this result, proven in Section 3, is that only causal correlations (encapsulated in those homeostatic patterns which participate to a given level as environments) could produce causal changes, *i.e.* changes in the current homeostatic pattern. The proof that the causal correlations are concentrated in homeostatic pattern is presented in [3] [4]. A simple explanation is grounded on the permutation sensitivity of the components which participate in any discrete pattern. Indeed, any change of positions and/or intensities of any components result a new pattern. Thus, all the discrete patterns share the exclusive property of causality, namely the permutation sensitivity of the order cause-effect. Yet, this form of causality is different from the traditional view on causality considered as a specific ordered sequence of binary relations cause-effect.

The fundamental role of the continuous band in each and every power spectrum which originates from minor individual responses compatible with the current homeostatic pattern [3] is that it renders the corresponding homeostatic pattern to be permanently bounded in size both in the space and in time. Figuratively speaking, its exclusive generic property is that it spontaneously sets specific constraints to the spread of any concrete dynamical equilibrium in the space and in time regardless to the details of the intra- and inter-kind interactions. As

a result the state space of any dynamical equilibrium turns partitioned into bounded in their spatio-temporal size domains of different homeostasis.

Thus, the fundamental novelty of the present model is that the evolution in the setting of the concept of boundedness is always a causal process both on the level of mutations (intra-kind interactions) and on the level of inter-kind interactions. A far going consequence of that result is that the established equilibrium is dynamical one so that neither mutation and neither kind dominates forever on the contrary to the survival of the fittest approach where a single mutation turns dominant over the entire system forever.

2. Decomposition Theorem and the Intra-Kind Equilibrium

The subject of the present section is to consider the major exclusive properties of an already established intra-kind equilibrium. Let us start with the consideration that each mutation commences from specific to its kind bounded set and it interacts both with its current environment and neighboring mutations. The interactions among mutations are specific to each mutation and the corresponding environment but generally they are of two types: synergetic ones, *i.e.* interactions which act in favor of all participants and competing interactions which act in favor of dominance of a single participant. It is important to stress that since the environment acts non-homogeneously over the corresponding system, the outcome of interactions varies throughout a system and in the time course. Then, I suggest the definition a dynamical equilibrium to be: the response from each and every spatio-temporal point of a system is permanently self-sustained to be bounded and well-defined.

Then, the major question becomes whether there exists general operational protocol insensitive to the details of interactions which provides existence of a dynamical equilibrium. The high non-triviality of the matter lies in the fact that no Hamiltonian-type description for systems which exert competing interactions is available [5]. Therefore, the positive answer to the above question calls for fundamentally novel approach. Next it is demonstrated that the recently introduced concept of boundedness and more precisely its central result, the decomposition theorem, are able to provide a positive solution to this issue and to delineate the exclusive characteristics of any dynamical equilibrium regardless to the details of intra-kind interactions.

The definition of the dynamical equilibrium, viewed as establishing of permanent boundedness of the response in a long-run, renders the mathematical description of any such response to be presented as a BIS. As it has already been mentioned, an exclusive generic property of any stable BIS is that it is subject to decomposition theorem. To remind, it proves that the power spectrum of any BIS is additively decomposed to a specific discrete pattern, called homeostasis, and a continuous band of a universal shape so that both the structure of the discrete pattern and the shape of the continuous band are robust to the details of environment as long as the homeostasis of the latter stays intact. To remind, ac-

cidental correlations are eliminated from the power spectrum because they are short-lived and thus their impact is averaged out. Put in other words, the power spectrum comprises only steady in a long-run correlations and thus appears as most appropriate characteristic of a dynamical equilibrium.

Let us now consider the exclusive generic properties of specific discrete patterns and universal continuous bands and to consider the highly non-trivial role of their persistent coexistence.

First in this line comes the exclusive generic property of discrete patterns to comprise only causal correlations. This assertion is an immediate consequence of the fact that positions and intensities of the components in each discrete pattern along with the ratios among the latter are permutation sensitive. It implies that any permutation and/or modification of the intensities, e.g. any switch between any two components, results in a new pattern. It should be stressed that this form of causality fundamentally differs from the traditional view on causality as a binary ordered relation cause-effect. The difference is best pronounced through the fact the novel form of causality is an emergent generic property from a sea of interplay among short-ranged and long-ranged interactions.

The generic role of the continuous band is also highly non-trivial: as considered in [3] [4] it originates from minor individual responses compatible with the current homeostatic pattern. Its fundamental role is that it renders the corresponding homeostatic pattern to be permanently bounded in size both in the space and in time. Figuratively speaking, its exclusive generic property is that it spontaneously sets specific constraints to the spread of any concrete dynamical equilibrium in the space and in time regardless to the details of the intra-kind interactions. As a result the state space of any dynamical equilibrium turns partitioned into bounded in their spatio-temporal size domains of different homeostasis.

As a consequence of the above generic properties an exclusive generic property commences. It is that neither mutation dominates both in a short and a long-run. Thus, in a short run a given spatio-temporal pattern, much resembling a landscape, is established and develops in the space and time like a living organism: from “birth” to “death”. In a long run, the pattern development retains the same homeostasis on the “re-birth” as long as the environment keeps its homeostasis intact. Yet, on change of its current homeostasis, a new dynamical equilibrium, *i.e.* new pattern of mutations is established.

Next in the line of our considerations the matter why only changes in the homeostasis of the environment are able to cause changes in a dynamical equilibrium comes. Indeed, changes in environmental homeostasis are global in the sense that its impacts are spread throughout entire system in a persistent way. The latter implies that the impacts undermine the same critical points of any current equilibrium persistently on each “birth-death” cycle until the collapse of the latter happens. It is worth noting that this process is insensitive to the intensity of impacts. On the other hand, local accidental impacts, even of large inten-

sity, most probably remain local and short-lived. As it has been already mentioned, this is a direct consequence of the very notion of a power spectrum where accidental correlations are averaged out and thus do not participate in it. To remind, a power spectrum of a system in equilibrium comprises only steady reproducible correlations. It is worth noting that individual correlations which belong to a continuous band participate to the process as the major factor for constraining the size of the spatio-temporal domain for the operating of any equilibrium bounded. In turn, this renders equal evolutionary value of all mutations (all individuals) in a long run.

It is worth to consider the value of the existence of individual responses, despite their equal evolutionary value. To compare, suppose that all individual responses are identical. Then, the power spectrum in equilibrium would comprise only a discrete band. In turn, the dynamical equilibrium would turn into a periodic function spread throughout entire space and time. Therefore, the effect of any change in the environment would require infinite energy/matter/information for restoration of the equilibrium or for establishing a new one. Thus, the wisdom of confinement of the dynamical equilibrium into bounded spatio-temporal domains is three-fold: 1) it provides adaptability of the equilibrium to environmental changes; 2) it prevents the spread of a violation of an equilibrium by means of confining it to a local event; 3) it provides the evolution of a system to be substantiated by means of well-defined bounded jumps among different homeostatic patterns.

It is worth reminding that mathematical foundation for substantiating the above scenario is the use of BIS instead of until now dominant use of periodic functions.

3. Inter-Kind Equilibrium and General Protocol for Compatibility

It is obvious that a long-term coherent coexistence of different kinds is not always possible. That is why, the subject of the present section is establishing of the general characteristics of general operational protocol for compatibility of different kinds that constitute an eco-system.

The general prerequisite of such protocol commences from the idea about hierarchical structuring of complex systems. The latter asserts that each and every complex system is hierarchically organized so that each and every hierarchical layer along with its constituent responses with bounded intensity to specific stimuli. The gain of such distribution of impacts is three-fold: 1) it strengthens the overall response by means of an increase of the types of stimuli to which a system respond in a controlled way; 2) each and every unit should sustain its internal dynamical equilibrium, *i.e.* equilibrium among its mutations, intact; 3) keeps the damages local as long as possible. An exclusive for this type of hierarchy property is that though the response is specific and diversified, it is always bounded, the decomposition theorem holds at each and every hierarchical level.

Then the environment to a given hierarchical level comes from all other levels. Yet, the pre-dominant influence comes from the nearest lower and higher level. It is worth noting that this type of hierarchy is permanently bi-directional, *i.e.* it goes both bottom up and top-down unlike the pyramidal one which goes only top down and thus it turns vulnerable to tiny accidental perturbations.

As a result, each and every unit at each and every hierarchical level appears as a sub-system which has its specific internal structure and functionality and which is put in an ever-changing environment and whose behavior is subject to the concept of boundedness. Since each and every such sub-system has bounded “life-time”, the state space of the entire hierarchy consists of a hierarchy of domains each and every of which is characterized by specific to it homeostatic pattern. The crucial for the further considerations fact is that the inter-unit interactions must meet a condition which consists of avoiding resonances among homeostatic patterns which come from different hierarchical levels. It is worth reminding that the avoidance of interference implies sustainability of the intra-structure of the corresponding unit while the avoidance of resonances implies maintenance of the boundedness of the response.

This requirement constitutes the foundation of the general protocol of compatibility. The need of compatibility commences from the need of avoidance resonances among homeostatic patterns that come from different hierarchical levels. This requirement implies that frequency domains that come from different hierarchical levels must not overlap. The non-overlapping of the frequency domains is necessary for avoiding interference and/or resonances with units that come from other hierarchical levels with the homeostatic pattern of any given one.

Then, eco-systems which meet the protocol of compatibility exert long-term stable behavior. The major exclusive property of the latter is that it consists of specific sequence of spatio-temporal intervals each of which is characterized by its homeostatic pattern. Thus, one causal pattern is replaced by other; after some time the latter is replaced with a new one and so on.

Yet, two major questions arise: 1) does this form of causality implies just a long-term predetermination of the evolution; 2) if not, how new patterns arise?

The answer to those questions commences as two aspects of the same fact which is that the motion of a stable hierarchy generically passes through bifurcation points. Here, we use the term bifurcation in a slightly modified way, namely: it represents the point where several units turn admissible for the further motion of a given unit. The generic existence of such points of bifurcation is set by the general structure of the state space which consists of its partitioning into bounded domains. Further, since controlled bounded response of the over-all system is available only when the behavior of all constituents and units at each and every hierarchical level is subject to boundedness of rate and amplitudes of exchanging matter/energy/information with the corresponding environment, the motion in the state space happens only among adjacent domains. Then, bifurcation points

present everywhere where there is more than one adjacent domain admissible.

The major question is whether this is a random choice among equally admissible alternatives? If so, does this randomness break the predetermination? Yet, though this choice seems random, it is a choice among causal alternatives and implies just a “jump” in the causality, *i.e.* one homeostatic pattern is replaced with another.

I assert that the choice among admissible alternative is a new type of a causal process which possesses the exclusive property of the randomness not to be exactly reproducible. To elucidate this matter let us consider how the process of choice develops. At the bifurcation point, the formation of clusters of different alternatives starts to appear and develop. Here again the interactions are specific of each alternative but they are of the types presented in the Introduction, namely synergetic and competitive. Yet, now the goal is different, namely it is establishing of complete dominance of one of the admissible alternatives. This goal is achieved by that alternative which establishes dominance first. Thus, this renders the choice among admissible alternatives path dependent and thus probabilistic-like in the sense that it is not reproducible in full details on repetition.

It is worth noting that, although the choice looks like a probabilistic process, its consideration in probabilistic terms is inappropriate because clusters of each alternative comprise different causality. However, an exclusive outcome of the decomposition theorem is that not only the difference in causality of both alternatives is qualitative, but they are algorithmically unreachable from one another. This is an outcome of the full proof of that theorem which states that a full power spectrum is algorithmically un-reachable in finite number of steps from any other although, at the same time it is physically reachable by means of involvement of bounded matter/energy/information [1].

It is very important to stress that establishing of a single alternative over the entire unit is fundamentally different from the survival of the fittest. Here, each alternative is advantageous and thus the dominance is of not that of the fittest one but of the first one that reaches global domination. Alongside the dominance of single “chosen” alternative has limited spatio-temporal span: it is established over bounded spatial area and has specific to it “life-time”. On “re-birth”, another alternative could be established. In turn, the dominance of a single selection is always temporary and confined.

Now the matter about the commencing of a new unit comes into consideration. It appears as a specific response to the path dependence of the choice among admissible selections at a bifurcation point. It could happen when a current configuration of clusters allows interference and/or local resonances among certain clusters.

Yet, the matter about the stable incorporation of a new unit into the entire hierarchy is apriori mathematically undecidable as it has been demonstrated in [3]. In general it either fit in the entire hierarchy or died out, or triggers a global

catastrophe. Let us start with considering in more details the case of incompatibility: it implies that in a short run the new pattern would be destroyed. Then, its effect on the entire evolution would appear as a constrained local accidental correlation. On the other hand, when the new pattern is compatible with the entire hierarchy, it provides new route of the evolution. The third alternative is substantiated when a local catastrophe drives a global one.

4. Non-Predetermination Viewed as New Reading of Central Limit Theorem

In general terms, not-predetermination of the evolution implies its behavior is to be described as a Markov process with non-constant, yet bounded memory radius. However, the question arises whether the evolution is a stable process and consequently how this matter is related to the behavior of the corresponding system. The criterion for the stability of a Markov process, under the mild condition of self-sustaining permanent boundedness of rates and amplitudes of exchanging matter/energy/information with an ever-changing environment, is the form of the shape of the power spectrum as established in [6 FNL]: whether it comprises continuous band of the shape $1/f^{\alpha(f)}$ or it is white noise. If the answer is positive for the first alternative two questions arises: what forms the spatio-temporal boundaries of the entire system and how to distinguish the physical correlations which come of the Markov process and the functional correlations which come from the boundedness of rates and amplitudes.

However the notion of Markovianity encounters highly non-trivial puzzle with regard to the up-to-date unforeseen fact that the probabilistic description is also subject to the decomposition theorem. This is because all probabilities, regardless to their origin and processes they describe, are bounded between zero and unity. Then what is independent event, e.g. tossing of a coin and how to describe it? Further, thus established constraint implies that any process described probabilistically is subject to the decomposition theorem. It is worth noting that the derivation of the decomposition theorem is explicitly grounded on the Lindeberg theorem [7]. Thus, since according to the latter each BIS has finite mean and variance, so does claim the Central Limit Theorem (CLT). Then, the following vicious circle arises: on the one hand, according to Lindeberg, each and every stable in a long run BIS has steady mean and variance. Then, according to current formulation of CLT, the asymptotic distribution tends to normal. However, according to the decomposition theorem, the asymptotic distribution is power dependent and has long tails. Its major property is insensitivity to the way of description of the characteristics of the members in a time series. Moreover, it is insensitive whether their formulation follows the same standard both in space and in time. Since all probabilistic approaches put recordings to the same frame of boundedness, the criterion which formulation of the CLT works for natural processes is the asymptotic shape of the statics: whether it tends to normal distribution or the power dependence. At that point again it is a priori mathematically undecidable whether the process makes an U-turn or bump into thresholds

at stage of rapid acceleration. Yet, if a statistics changes in a space-time course, it is mathematically undecidable a priori whether it would damp or accelerate. The mechanism of limitation of possible damages to local is the partitioning of the state space and the space time to bounded domains. Figuratively speaking, partitioning acts as a self-organized decentralized control over the evolution viewed as a stable in a long run process. Yet, the question arises: what are characteristics of a steady bounded spatio-temporal landscape: in power spectrum it appears as a specific discrete pattern where position and intensity of lines are reproducible in an ever-changing environment with constant characteristics. The time-translational invariance of that landscape is provided by the presence of accompanied continuous band of the shape $1/f^{\alpha(f)}$. To elucidate the smoothness of that band implies that metric-dependent specific structure is embedded in an underlying “see” of Euclidean metrics. Note that the metric of any landscape is specific and local in space-time to it while the metrics of the “see” is universal. In consequence the specific repeatable relations encapsulated in any discrete landscape are provided time-translational invariant in the sense that their operation does not depend on the choice of a reference frame and regardless to whether the latter is local or global.

Yet, the establishing of a stable functionality over a steady structure resolves in a highly non-trivial way: a structureless BIS is subject to universal distribution presented in [1]. It seems plausible to suggest that a specific steady spatio-temporal pattern would persist as a specific steady spikes embedded onto the universal distribution. Note that the shape and positions of these spikes are specific outcome of the interplay between the morphology of the active sites, the motion of relaxing species and the bounded velocity of any process. The novelty is that the characteristics of local events are interrelated by means of morphology-dependent factors. In turn, this transforms short-ranged interactions into long-ranged and makes the local dynamics global, for example see [8] [9]. The presence of continuous long-range tail implies that the fluctuations from the steady pattern, though arbitrary, stay within the thresholds of stability. To compare, the normal distribution implies that the deviations from the mean are random yet unbounded events.

Thus, CLT suffers inherent contradiction: while the probability for any event is bounded, the outcome is that the deviations from the steady mean are independent and unbounded. However, the succession of random events implies that the corresponding transition rates define ill-defined velocity since there are no correlations between the successive transition rates which in turn renders that it is impossible to define velocity as an independent from the concrete particularities of succession of the transition rates. Further, it is impossible to define the notion of velocity as insensitive to partitioning variable. In turn, it renders corresponding system unstable: it is vulnerable to any large fluctuation and its occurring is unpredictable because the fluctuations are independent events. Further, this scenario renders impossible to define collective behavior because it is impossible to define collective variables which are independent from the way

of partitioning. Moreover, it is impossible to define any ecosystem because there is no way to synchronize their behavior because the velocity of all species is ill-defined.

In conclusion, it does not matter which one of both competing networks win, the result is total dominance of a single pattern and again its stability is subject of the CLT viewed in above meaning, namely a system becomes unstable under large enough fluctuation (or sequence of fluctuations) whose appearance is absolutely unpredictable.

Luckily, there is way out and it is the formation of a collective dynamics out of bounded in size and life-time landscapes each of which has its own dynamical equilibrium. The crucial step forward is the limitation both from below and above of the size and life-time for stable operation of any cluster regardless to the details of its dynamics [1] [10]. It is worth noting that the corresponding thresholds are specific for each landscape but their existence and boundedness are generic. The formation of a new collective dynamics happens again by means of motion, both ballistic and diffusion. Then the collective dynamics is highly specific yet stable when its behavior in the time course is BIS which exhibits time series invariants established in Chapter 1 [1]. Then, the route to evolution could go via hierarchical super-structuring instead of waiting for a new critical mutation appears.

The advantage of the new route lies in the fact that the partitioning of the state space into bounded domains renders the set of bifurcation points dense transitive one. However, at any bifurcation point the evolution path turns multi-valued and a priori it is undecidable which selection is stable. Note that each selection starts as formation of local clusters but some selections develops through percolation which eventually forms a dominant single state which however is globally unstable regardless to the details of any concrete dynamics. On the other hand, other selections goes via formation of a collective dynamic from the bounded is space-time domains by means of constraining the operation of each of them in specific for any cluster limited margins. It should be stressed that this operational protocol is general in the sense that it does not depend on the origin and nature of mutations and the way they interact.

Actually, the difference between CLT and the decomposition theorem is that the first ignores the rate of development of any process while the latter takes the boundedness of rates explicitly. To the most surprise ignoring the finite rate of development implies infinite velocity of development of any process regardless to the details physico-chemical characteristics.

The above considerations allow the following generalization of the Law of Large Numbers: a stable BIS transforms in a stable BIS after any form of coarse-graining. Note that the latter implies that the stability of this form of scale invariance implies insensitivity of the time series invariants of both original and offspring BIS to the way partitioning is made. The Layapunov coefficient could not serve as criterion for stability: if it follows power dependence with non-constant power, the fluctuations stay within thresholds of stability whereas for unlimited

grow the Lyapunov coefficient grows exponentially. However, practically it is impossible to discriminate a power dependence from an exponential one by any means of computing since both algorithmic and semantic computing operates with finite presentations: truncated and round-off Taylor series correspondingly. Since both of them are polynomials regardless to any concrete precision, the discrimination is mathematically undecidable. The latter is an argument for self-consistency of the previously obtained result that it is a priori mathematically undecidable whether any change of the status of a system is adaptation or destruction. In turn, does the latter imply that it is mathematically undecidable by any practical means whether a change brings about adaptation or destruction?

Yet, the role of scanning over partitioning implies that the synchronization of all constituents of a system is stable to small perturbations. In turn this provides arrow of time and constant speed of thus synchronized orchestra of “clocks” viewed as a single unit. It is worth noting that this arrow and speed is specific for any given unit. Thus, the question arises whether there is absolute time.

A criterion for synchronization of all processes in a unit is the development of an excursion: each excursion consists of steps produced by processes that operate at different spatio-temporal scales. The synchronization implies that all of them proceed with the same velocity. The latter provides the formation of a monotonic trend and the development of stretching at first because it is the only way to depart from the mean. However, any departure from the mean implies weakening the correlations. This provides a general shape of an excursion to be monotonic increase with gradual change of curvature. Eventually, the curvature reaches a critical point where it turns to zero. This is a point of bifurcation type: 1) the first scenario is to make an U-turn and to start development in the direction of gradual increase of correlations (folding); 2) the second scenario is to continue development and thus to bump into thresholds where it can either be damaged or destroyed. Yet, even if survives, the bumps into thresholds render the system to function unsteadily and eventually to stop functioning. It is worth noting that unlike the second scenario, the first one provides long-term stable functioning of a system. The high non-triviality of this type of bifurcation point is that the choice of a scenario is matter of the inherent functional organization not a random one. Note that if the choice was random, the unstable behavior would be the only alternative. Yet, for excursions below thresholds there is choice at the corresponding bifurcation point. Yet, the choice is not completely random, but it is a highly non-trivial interplay between current organization and the current environment provided by the nearest hierarchical levels.

The above scenario for synchronization is best revealed through the continuous part of the power spectrum where the shape ([1], chapter 1) implies that all scales contribute in a covariant manner, *i.e.* the spectrum does not signal out any specific spatio-temporal scale. In turn this sustains the idea about the proposed protocol of hierarchy to be that the latter goes both bottom up and top down.

It is worth noting that in order to provide permanence of the constant velocity

at synchronized systems the size and time interval of jumps should follow bell-type distribution. However, though it could be well-approximated by the Gaussian one, it is only in the sense that it has finite mean and finite variance. However, the latter is also what Lindeberg theorem says. The criterion for discrimination between normal distribution and the bell-type one whether the histograms are distributed at finite area while for normal distribution they should be scattered at very large areas. Other criterion is that normal distribution has only two moments: mean and variance while any stable BIS has infinite number of higher moments [1].

5. Conclusions

It is demonstrated that “survival of the fittest” approach suffers fundamental flaw planted in its very goal: reaching a uniform state starting from a minor random event. However, desired uniform state is globally unstable. The latter is unavoidable because this approach is grounded on the conjecture that a local random event, e.g. mutation, rapidly develops via eliminating all its rivals so that to reach its ultimate goal: spreading throughout entire system. Thus, on arrival at it, a system stays there forever.

Yet, the dominance of a single mutation over all others not only does not increase the strength of the corresponding system, but on the contrary, it weakens its stability by means of making the system vulnerable to a larger variety of hazardous events. To remind, the exclusive property of mutations is that each of them exerts specific robustness to a given environment. This issue is especially acute for systems put in an ever-changing environment. It is obvious that then, a single mutation is “fittest” only temporary: at the next instant another mutation turns more advantageous.

That is why a new approach to the evolution is put forward. It conjectures equilibrium for systems put in an ever-changing environment. The importance of this issue lies in the view that an ever-changing environment is much closer to the natural environment where the biological species live in. The major goal of the present paper is to demonstrate that a specific form of dynamical equilibrium among certain mutations is established in each and every stable in a long-run system. The major result of our considerations is that neither mutation nor either kind dominates forever because a temporary dynamical equilibrium is replaced with another one in the time course. It is demonstrated that the evolution of those pieces of equilibrium is causal, yet not predetermined process.

An important consequence of the view on evolution as a causal process provides another powerful argument in favor of the forwarded by the author ban over information perpetuum mobile [11]. To remind, it asserts that it is impossible to transform noise into information. Now this ban is confirmed through rendering new things to commence from a specific causality not from randomness.

Outlining, the long-term evolution is a causal though not predetermined process whose development is presented as a BIS. The far going consequences of

the latter are that any such eco-system is open to further hierarchical super-structuring the long-term evolution of which shares the same properties of being both causal and not predetermined.

Yet, the fundamental question is whether a long-run stability of any evolution is asymptotic. Moreover, is asymptotic stability ever possible and even if so; is it detectable by any means?

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

- [1] Koleva, M.K. (2013) Boundedness and Self-Organized Semantics: Theory and Applications. IGI Global. <https://doi.org/10.4018/978-1-4666-2202-9>
- [2] Koleva, M.K. (2021) *Journal of Modern Physics*, **12**, 605-622. <https://doi.org/10.4236/jmp.2021.125039>
- [3] Koleva, M.K. (2020) *Journal of Modern Physics*, **11**, 767-778. <https://doi.org/10.4236/jmp.2020.116049>
- [4] Koleva, M.K. (2019) *Journal of Modern Physics*, **10**, 43-58. <https://doi.org/10.4236/jmp.2019.101005>
- [5] Giampaolo, S.M., Hiesmayr, B.C. and Illuminati, F. (2015) Global-to-Local Incompatibility, Entanglement Monogamy, and Ground-State Dimerization: Theory and Observability of Quantum Frustration in Systems with Competing Interactions. arXiv: 1501.04642.
- [6] Koleva, M.K. and Covachev, V. (2001) *Fluctuation and Noise Letters*, **1**, R131-R149. <https://doi.org/10.1142/S0219477501000287>
- [7] Feller, W. (1970) An Introduction to Probability Theory and Its Applications. John Wiley & Sons, New York.
- [8] Koleva, M. and Petrov, L. (1999) *Bulgarian Chemistry and Industrie*, **70**, 27-35. <http://arXiv.org/cond-mat/0308616>
- [9] Koleva, M.K. and Petrov, L. (2018) *Emerging Trends in Kinetics and Thermodynamics*, **1**, 19-27. <https://doi.org/10.36959/672/588>
<https://scholars.direct/Articles/kinetics-and-thermodynamics/etkt-1-003.php?jid=kinetics-and-thermodynamics>
- [10] Koleva, M.K. (2021) *Journal of Modern Physics*, **12**, 167-178. <https://doi.org/10.4236/jmp.2021.123015>
- [11] Koleva, M.K. (2017) *Journal of Modern Physics*, **8**, 299-314. <https://doi.org/10.4236/jmp.2017.83019>