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The resistible ascent of Homo Oeconomicus. A biologist's view

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Abstract

The debate on biological evolution has long developed with an opposition between a mechanistic and a holistic/complex vision of life. The differences between these two visions are discussed – starting with Darwin and Lamarck - and re-defined in the light of the current discussion, opposing a "DNA-centric vision of life" to a "complex systems approach". Human evolution is unique, and so is our adaptive strategy, based on the capacity of actively changing the environment, instead of being selected in a passive way by it according to our genetic complement, as it happens with other animals. For humans, behavioural and symbolic sources of variability are crucial in their adaptive strategies. The mechanistic view on the interaction between humans and living systems, however, has dominated the process of industrialization with its "dogma of infinite growth", leading to a widespread destruction of nature and to a frightening acceleration of climate change.

Sintesi

Il dibattito sull'evoluzione ha sempre contrapposto una visione meccanicistica e una visione olistica/complessa della vita. Le differenze tra queste due prospettive sono discusse - a partire da Darwin e Lamarck - e ridefinite alla luce del dibattito contemporaneo, che contrappone una "visione della vita centrata sul DNA" ad un approccio che affronta "sistemi complessi". L'evoluzione umana è unica, così come la nostra strategia adattiva, perché si fonda sulla capacità di cambiare l'ambiente, anziché essere selezionata in modo passivo dall'ambiente stesso, sulla base del nostro corredo genetico, come accade agli altri animali. Per gli esseri umani, le fonti di variabilità comportamentali e simboliche sono cruciali per le strategie adattive. La visione meccanicistica dell'interazione tra esseri umani e sistemi viventi, tuttavia, ha dominato il processo di industrializzazione con il suo "dogma della crescita infinita", che ha provocato una grave distruzione della natura e una preoccupante accelerazione del cambiamento climatico.

The term "evolution" may define all temporal processes of change of whatever dynamic system. In the specific case of biological systems, when we study and discuss the structure and dynamics of evolution we tend to add to it positive adjectives attributing to biological changes in time a positive "value", and positive objectives to be aimed at. According to monotheistic religions in particular, the value and/or the objective are supposed to have been pre-defined by a transcendent factor, the aim being the birth of our species, Homo sapiens, to be reached through a linear process of "improvement" of living systems. On the contrary, the positive value attributed to biological evolution, according to the vast majority of students of natural and biological sciences, is immanent

and is generally attributed to the development of a set of processes and tools leading to the self-conservation of changing living systems.
However, within this frame, when we try to draw the "laws" of evolution we often diverge and the debate may become very harsh, the reason for this being that the discussion on life inevitably also concerns us, the humans, and therefore interacts with different ideas, philosophies, ways of living etc. Moreover, all of us, scientists included, live in connection with other members of our species and are influenced by the "spirit of times", an ever changing sort of "common systems of thoughts", which historians localize in different "eras" of humanity.
The ever-lasting discussion on the nature and modes of evolution is generally between representatives of two broad currents of thought, liable to be roughly defined as a mechanistic vs. a holistic/complex vision of life, both born at the very beginning of biological observation and research. In order to introduce the differences between the two visions and update them to contemporary times, I will offer a short summary of the present discussion, re-defining the two areas as a "DNA-centric vision of life" vs. a "complex systems approach". I shall start from the beginning of the twentieth century when both the Darwinian and Lamarckian theories were compared and discussed, avoiding the debate between science and theology. The "fundamental laws of evolution" according to Charles Darwin, as he wrote them in "The origin of species (1872)" include: a)The law of growth through reproduction; b) heredity, almost implicit in reproduction; c) variability due to the direct or indirect action of living conditions and use and disuse; d) a growth rhythm so high that it leads to a fight for existence and consequently to natural selection.
It is worth noting that in "The origin of variation" Charles Darwin added to these laws that of "correlated variation", that he considered as an unknown but basic rule of evolution. Translated in an updated language, the Darwinian "correlated variation" states that the changes of single components of living systems may occur, but only obeying to the unknown "rules" governing the non-additive dynamic interactions between the connected components of the whole system. Moreover, Charles Darwin, contrary to the opinion of many self-defined Darwinists or anti-Darwinists, never mentioned the concept of randomness: "On the other hand, I cannot anyhow be contented to view this wonderful universe, and especially the nature of man, and to conclude that everything is the result of brute force. I am inclined to look at everything as resulting from designed laws, with the details, whether good or bad, left to the working out of what we may call chance" (Charles Darwin, *Autobiography*, 1892, p.248, Letter to Asa Gray, 1860). He also wrote: "Let an architect be compelled to build an edifice with uncut stones, fallen from a precipice. The shape of the fragments may be called accidental; yet the shape of each has been determined by the force of gravity, the nature of the rock, and the slope of the precipice, events and circumstances all of which depend on natural laws; but there is no relation between these laws and the purpose for which each fragment is used by the builder" (Charles Darwin, *The variation of animals and plants under domestication*, 2nd ed., London, 1875, p.236).
Finally, the environment, in the Darwinian theory, at variance with a widespread opinion, had a very important role as it influenced directly and indirectly the variations, the most adapted of which being selected by the context. Both the correlated variation and the influence of environment on evolution have something in common with the conception of life offered by Lamarck, although officially Darwin would have never agreed to have any common thought with the French author of the "Phylosophie zoologique". The main tenets of Lamarck's conception of living matter as described in a chapter of his book are: "The molecules of an inorganic body are all independent one from another (…). On the contrary the molecules of a living body, according to their conditions, depend one from another because all of them are influenced by a cause which animates them and induces them to act; because that cause induces all of them to help reaching a common goal both in single organs and in the whole individual (…). Moreover, every living body is permanently animated by a specific force which, without ever stopping, induces the excitation of the movements

of its interior parts continuously producing changes in the states of these parts resulting in the repair, renewals, developments and a large amount of processes present only in living beings; this induces excited movements in the interior parts which modify and destroys them but also repairs and renews them leading to the extension of the duration of the existence of the individual (...). Finally, no inorganic body will die because inorganic bodies never are alive. On the contrary all living bodies inevitably are subjected to death (…). Life, in the parts of the bodies endowed with it, is an organic phenomenon which leads to many others; and this phenomenon only derives from the relations between the parts components of this body, the fluids contained by it and moving, the cause of the excitement and the movements and the resulting changes".

Unfortunately, probably due to the influence of the "modern era", the followers of Lamarck and Darwin developed two deterministic conceptions called "neo-Darwinian" and "neo-Lamarckian", both coherent with the "modern spirit of times" and its "Promethean utopia", according to which humans, proud of their incredible capacity of transforming the contexts, considered the whole Planet and its Biosphere as machines liable to be constructed according to human, science-led projects.

Probably the best synthesis of neo-Darwinism is the famous book published by a French geneticist, Jacques Monod, by the title of "Chance and necessity", where the author attributed genetic variability totally to chance, thus following the conclusions of Mendel and his modern followers, selection being operating not on the organisms, but mainly on genetic variations obtained by chance-led mutations. It was Monod who, following the discovery of the structure and shape of the carrier of genetic information described by J. Watson and F. Crick in 1953, called DNA the "fundamental invariant", that is the "container" of the wholly deterministic "information", wholly designing and controlling the lives of the individuals containing it, without any influence of the environment.

Contemporary to neo-Darwinism, also neo-Lamarckism was founded in the twentieth century, but localized in the Soviet Union and in the countries under its political influence. Also neo-Lamarckism was a deterministic theory, the main difference from neo-Darwinism being the fact that evolution was not directed by genetic variation and selection, but only by environmental conditions. The main reason for the fast rise and fall of this theory, initiated by an agronomist, T. Lysenko, and by a self-defined philosopher, Prezent, was its political meaning, as it proposed that plants and animals could improve their heritable performances through the modification of the agricultural environment according to national projects directed by the communist government and its agriculture Ministry. All this was supposed to show the superiority of Russian science on the Western one, that followed the neo-Darwinian selection of genetic variability.

As thoroughly discussed by Buiatti (2013), both deterministic theories were challenged in the Western world by a number of scientists introducing a new and more complex vision of life. For instance François Jacob, a friend and Nobel Prize co-winner in 1965 with J. Monod, developed a very different and complex theory and wrote in his book "The logic of life": "Every living being, says Goethe, has in itself the reason of its existence: all the parts react one with another (…). Living organisms are subject to different influences by non-living objects and other living beings (…). To cope with those actions an equal and opposite action is needed (…). In comparative anatomy a fragment is not anymore an isolated element: it is a sign of the organization of the whole (…); the relative relevance of an organ is measured through the constraints that it imposes on the others (…); only combinations satisfying functional needs of life are allowed. Life is (…) a play of interactions of organisms and environment: it is the dialectic of the same and the different within a unitary history of nature (…). It is not the matter which evolves, but rather the organization, the unit of emergence always capable to unite with other similar unities to become integrated in a system".

It is worth noting that a similar conception had been proposed earlier by the biologist and philosopher L. von Bertalanffy, who wrote in 1926: "Since the fundamental character of the living thing is its organization, the customary investigation of the single parts and processes cannot provide a complete explanation of the vital phenomena. This investigation gives us no information about the coordination of parts and processes. Thus the chief task of biology must be to discover the laws of biological systems at all levels of organization. We believe that the attempts to find a foundation for theoretical biology point at a fundamental change in the world picture. This view, considered as a method of investigation, we shall call organismic biology and, as an attempt at an explanation, the "system theory of an organism". As a matter of fact, von Bertalanffy himself recalled that this conception was coherent with Aristotle's one and wrote: "order was the Aristotelian world view with its holistic and teleological notions. Aristotle's statement, "The whole is more than the sum of its parts," is still a valid definition of the basic system problem. Aristotelian teleology was forgotten in the later development of Western science, but the problems contained in it, such as the order and goal-directedness of living systems, were negated and by-passed rather than solved".

To be sure, Von Bertalanffy was not at all alone in this battle, as he was a member of the group of scientists who belonged to the so-called "Prater Vivarium", an inter-disciplinary organization founded in Wien in 1903 by Przibram, von Portheim and Figdor and later joined by von Bertalanffy himself, the chemist Pauli, Paul A. Weiss - a physicist interested in biology who later on wrote a book on "Hierarchically organized systems" (1971) - and many others joining the parallel current of complex systems in physics introduced in 1891 by H. Poincaré, who showed the intrinsic unpredictability of the movements of three interacting bodies, and extended in 1963 by E. N. Lorenz, a meteorologist, who wrote a famous paper on "deterministic non-periodic flow".

These concepts were later on applied to evolutionary theory by S. J. Gould and N. Eldredge within the frame of a real revision of Charles Darwin's theory, where they challenged the Darwinian theory of a continuous, slow, linear process of evolutionary trends and proposed an evolutionary dynamics with periods of "stasis" intercalating with others of sudden acceleration of change. This theory was later on supported by studies on the hierarchical organization of biological networks from molecules into cells, tissues, bodies, ecosystems, the biosphere, whose single components are connected with varying numbers of others, thus forming modules "directed" by "hubs". Therefore at all levels the putative change of a hub will inevitably change the whole module, thus accelerating the overall modification of the system. In an interview, Gould (2000) argued that "Complexity theory can help us to understand why prediction is so difficult (…). I can tell you to the minute when the next eclipse is going to occur, because it's a simple system with limited interactions. I can't tell you where human evolution is going. Also, the mathematical analysis of complex systems composed of multiple, independent parts shows that a small perturbation can produce profound effects, because of the way it cascades through the nonlinear interactions of the system". It is not by chance that this statement may be applied also in physics, as shown for instance by the two physicists M. Paczusky and P. Bak: "The basic laws of physics are simple, so why is the world complex? The theory of self-organized criticality posits that complex behavior in nature emerges from the dynamics of extended, dissipative systems that evolve through a sequence of meta-stable states into a critical state, with long range spatial and temporal correlations. Minor disturbances lead to intermittent events of all sizes. These events organize the system into a complex state (…).This type of "punctuated equilibrium" dynamics has been observed in astrophysical, geophysical, and biological processes, as well as in human social activity".

Recently, Buiatti and Longo (2013) transferred the main concepts of complex system theory to biology and concluded: "one may soundly understand the formation of complex biological structures in terms of random explorations of continually new possibilities. In order to be viable, though, these must be integrated and regulated in an organism, or form a coherent structure, in a niche, in an ecosystem, as life is a complex blend of various forms of contingency and determination. For example, the known formation of organism-like colonies of differentiated and integrated bacteria or unicellular organisms, is the result of the random exploration by variability of a possible organization of life – of newly organized life, of course".

Obviously, these concepts and rules concern all living complex systems, including humans, whose survival through change is bound to variation and dynamic connections (cooperation) of the material, cultural and - why not? - economic components. Forgetting our material and "mental" nature and their interactions would necessarily lead our species to extinction. In other words adaptation is based on a high level of variation, on "passive" processes of selection of the organisms endowed with favorable genotypes and phenotypes, and on "active" behaviour that is the modification of the context. According to E. Jablonka (2004), the "tools for change" are mutations leading to genetic variability, "epi-mutations" that are heritable epigenetic modifications, i.e. changes of gene expression but not of structure, "behaviours" (active changes of the context), and "symbolic" variability. These sources of variability are differently used by different organisms; namely, bacteria mainly "use" genetic variability for adaptation; plants use genetic and epigenetic ones; animals use genetic, epigenetic and behavioural ones; humans use genetic, epigenetic, behavioural and symbolic ones.

As we shall see, human evolution is unique as discussed in Buiatti (2013), and so is our adaptive strategy, based on the capacity of actively changing the environment, instead of being selected in a passive way by it according to our genetic complement, as it happens with other animals. This is why our genetic variability is much lower than that of the other primates, even though they are few thousands, while humans are more than seven billion - as shown by Cavalli Sforza and his colleagues. The reason for this is that in our case, at a certain point of our evolution, probably less than 100,000 years ago, a few of our genes (probably less than hundred), all expressed and active in the cortex of our brain, accelerated the change acting as hubs capable of strikingly modifying human behaviours. Nowadays our cortex contains 100 billion neurons liable to be connected in one million billions potentially different combinations by synapses, quasi-random at birth and organized in the first 3-4 years through to the reception of human signals. Signals from animals do not have the same effects, as shown by the fact that humans reared by wolves or other mammals are handicapped, probably as a consequence the biased reception of non-human signals.

Most probably the first genes involved in the acceleration of change were those like microcephalin and ASPM, involved in the growth of the neo-cortex. This led to a modification of the ratio between the size of the encephalon, whose ratio with the rest of the brain is now in humans 7.4-7.8, while the bottlenose dolphin (with 5.3) and the white-fronted capuchin (with 4.8) are the second and third animals for this parameter. The enlargement of the encephalon led to an escalation of neuron numbers in the cortex, the differentiation of cortex areas, the spreading of the neuron-mirror system, the configuration of comprehensive neurocognitive nets. Moreover, other genes, and particularly those of the FoxP group have also accelerated their change, leading to the birth of human languages and the consequent improvement of communication, along with others improving neural connection, plasticity, perception, high conductivity of cortical fibres etc.

It is worth noting that, while the subdivision of large areas of the brain is considered a part of embryo development controlled by few specific genes, synapses are quasi-random at birth and become organized in the first 3-4 years after birth through the reception of human signals and the elimination ("pruning") of those not receiving them. It is worth stressing here that the process of "pruning" and in general of changes in the organization of the brain continues, although with much lower intensity, during almost the whole life. All this evidence seems to suggest that at least a large part of our humanity is due to the continuous "inventions" by a very species-specific brain, with a very high capacity to receive information from other members of our species, but not other ones, to conserve it, and use it for the configuration of up to a million billions different neuronal combinations.

A further proof of the relevance of our extraordinary capacity of human signal exchange has been shown by a recent study where physical and social performances of 2.5 year old human children have been compared to those of chimpanzees of equivalent age. In this experiment all kinds of performances were comparable between the two species, with the exception of the capacity of receiving information from members of the same species, much higher in humans than in the primate counterparts. The exchange of information is therefore most probably the main reason for the "invention" of our innovative adaptation strategies, based on the active production of projects of change of the environment aimed at rendering it adapted to our needs.

Probably, the best description of the differences between animals and humans is offered by a Jewish philosopher, Hans Jonas, who summarized and described with three metaphors the main features of humans, absent in all other living being, namely the presence of "images", "tools" and "graves". The metaphor of the images stems from the capacity of early humans to paint on the rocks, not photographic but "aesthetic", images deriving from non-material brand-new "projects" constructed in the brain of the painter and projected on the external matter of rocks, thus producing completely new, "humanized" versions of the objects observed. This capacity of inventing "images", paint and convert the images into projects allows us to imagine tools not present in nature, allowing our ancestors to start moulding the external matter according to their needs.

The last - but certainly not least - human capacity according to Jonas is "the grave", meaning by that the capacity to develop thoughts wholly independent from the information coming from the exterior, in terms of transcendence, philosophy and in general human cultures. It is worth noting that all these capacities have been for a long time shared by four species of the genus Homo, namely ours, Neanderthalensis, Denisovianus, Floresensis, all capable of modelling caves, burying their dead in graves along with tools for a possible future life, and constructing "aesthetic" ornaments. Jonas developed this conception in "Organismus und Freiheit" (1973), a very important text on the differences between non-living and living systems, humans included, where he also confirms in a detailed way the specific features of living complex systems, published only one year after the already mentioned work by Gould and Eldredge on punctuated equilibria.

After the birth of our species in terms of the material organisation of the bodies - including the development of the brain and the extraordinary tools for the exchange of information and the production of wholly original thoughts and projects -, further human evolution was mainly behavioural and cultural, material changes becoming almost irrelevant for adaptation. In the early periods of our presence in the planet, humans were travellers, moving from one place to another, collecting plants and fruits, hunting animals, constructing simple tools, later discovering the use of fire to cook and to chase away carnivores, organising caves to hide etc. In those time "economy" was probably limited to the exchange of useful objects like tools for hunting, simple weapons and so on, and humans - as other animals - adapted themselves to changes in the environment by moving, in the continuous search of optimal contexts. In this period Homo did not yet develop whole projects and rules ("nomoi") for changing the environment ("oikos") in a rational and stable way. This happened later on, when nomads stopped their wandering and settled in chosen areas where they started to build stable villages and towns. Most probably it was in that period that different habits and languages were developed, communities built, different cultures and "religions" being born and stabilised. It was in those times, from 10,000 years ago on, that agricultures were developed, animals and plants were selected according to the local environments and needs of the population, and humans started modifying ecosystems according to their needs.

Many scholars of archeo-economy tend to consider "economy" the production of food through agriculture, the construction of shelters and other tools before the invention of money for the numerical estimation of the value of exchanged objects. An early interesting description of economy as a general human process is that given by F. Giddings (1909) who wrote: "The economy of plant life is organic only. The economy of animal life is organic and instinctive. The economy of human life is organic, instinctive and rational. Man alone systematically attempts to improve his condition. His first experiments, however, directed by animistic conceptions of nature, are with the arts of enchantment and propitiation. His economy is ceremonial. Not until late in his career does he become a systematic worker and develop a business economy". According to the same author all changes improving human "satisfaction" are part of economy: "The original wants of an organism, then, are those of energy-supplying substance, and of stimuli provocative of energy discharge (…). The human race still subsists by foraging rather than by producing. We consume great quantities of wild fruits and of game, of medicinal barks and herbs, of furs and feathers which are merely gathered, and are not increased in supply by any process of breeding or cultivating (…). There is a fourth array of satisfactions, consisting substantially of stimuli of bodily and mental activities, intellectual and emotional, which are enjoyed only by man, and the origins of which we have been describing. Originally developed with the intent to multiply food supplies, they become important to man for the sustenance of mind and soul rather than of body. Language and manners, plastic and poetic arts, amusements and worship - these involve productive intent and effort, and in the beginning they are regarded as productive means, as truly as capital is in modern days. Nevertheless, they are in reality productive of subjective satisfaction, rather than of material goods, and so are not properly to be classed as agents of a productive economy. The fifth and final array of satisfactions is that which is created by modern productive industry. It comprises the great bulk of our food supplies, and of our clothing, comforts and luxuries and their creation involves the production also of great quantities of auxiliary goods, including tools and machinery and means of transportation."

I quote these sentences because they perfectly reflect the dynamics of changes of human action from the very beginning to the industrial era. At the beginning humans modified the context with the aim of improving their survival, but at the same time developed "immaterial" changes inventing the arts (the early "images"), but also myths and religions and exchanged products of early industries attributing to them different values mainly correlated with their utility in everyday lives. Then the money was invented as a tool to speed up exchanges but still correlated to the level of utility. In those times a rich and powerful family was one that owned soil, cattle, houses etc., all the material goods needed for combating hunger and living in a comfortable situation. It was much later that industry became an objective as such, a rich man being a person who owned a large industry, sold its products and accumulated money to be used for further increases of production.

This was the time when humanity entered in the era I call "the promethean Utopia" and constructed the "Anthropocene" (Crutzen), a new planet wholly built by humans according to their projects, the whole world, living systems included, being considered a huge man-made machine. Hans Jonas was one of the first philosophers to be fully aware of the possible dangers coming from the "Utopia" and proposed his "Imperative of responsibility" where he asked humans to discuss not only the direct effects of their planned modifications, but the unpredictable effects of their interactions with the dynamical complex network of the planet. H. Jonas wrote: "Modern technology and its products spread all over the globe, their cumulative effects putatively reaching an unlimited number of future generations. What we do here and now, mostly only thinking about ourselves, affects in a massive way the life of millions elsewhere and in the future, millions that did not have any say about our doings (…). We mortgage the future life for present short-term gains and needs (…). Perhaps we could not entirely avoid behaving like this, but in that case we have to use extreme caution so that we operate in all fairness towards our descendants, namely so that their capacity to pay back the mortgage is not compromised from the start (…). The ethical category that above all is called into play is responsibility (…). This extended global view point connects the human good with the cause of life as a whole, and guarantees non-human life rights on its own."

Unfortunately this principle, by far stronger and more precise than the "precautionary principle" of the environmentalist movement, has not been followed by Homo sapiens, who on the contrary keeps acting according to the dangerous suggestions of the Modern Era. In other words, although contemporary life sciences changed the basic models and paradigms of living matter and discussed the differences between it and the non-living one, the main goal of humans still is the mechanical "humanization" of the whole world, forgetting that "machines" are very different from living systems and inevitably interact with life in an unpredictable way.

This change of objective of our species in the Modern era necessarily also changed the scale of values in human lives. At first, the highest level of "satisfaction" - in the terms of Giddings - was connected with life and well-being; the powerful and honoured people were those who owned large farms, houses and all tools needed for a good material and cultural life. Conversely, in the modern era the objective became the ownership of industries and a high capacity of mechanisation of the world through industrial production and a winning impact on the market. It is in modern times that technology is the symbol of "satisfaction" and power, while science - and thought in general - is pushed back at a secondary level.

One of the first examples of the direct application of the mechanistic view to living systems and the possible dangers deriving from it has been the "green revolution", a world-wide project supported by the Food and Agriculture Organisation (FAO) of the UN, whose aim was to obtain "optimal" and therefore "homogeneous" plants and animals to be cultivated and bred throughout the whole world, irrespective of the different environmental, social, economic conditions of the contexts. Breeders were therefore taught to develop ideal projects of optimal plants and animals, forgetting Darwin's "law of correlated variation", using selection on traits one by one, and aiming at "optimal" varieties and breeds derived not by the interaction between the different parts of organisms and between organisms and the environment, but by addition of new traits. Optimization meant therefore homogenization and destruction of extant "non-optimal" genetic variability, forgetting the possible negative "unintended" interactions between the genes in plants and animals and those with the different contexts, social systems included.

Moreover, to counteract the unavoidable problems produced, humans used machines, chemicals of all sorts, all deadly tools for the maintenance of agro-ecosystems. As a consequence, at first global food production in Asia and Latin America increased, leaving Africa behind, and the number of undernourished people decreased from 1980 until 1995, but it later increased again up to more than one billion. The overall result of the change from "subsistence" agricultures to industrial ones led to the loss according to FAO, of 75% of domesticated plant and animal biodiversity, a treasure critical for human survival needed to counteract environmental changes, and particularly the effects of human produced deadly acceleration of climate change.

It is not by chance then, that, one year after the beginning of the new increase of famine, the first Genetically Modified Plants entered into the market, advertised as putative "miracle plants" liable to cancel famine. Since 1996, only four of them (soybean, maize, canola, cotton), modified for two characters only (resistance to insects or to herbicides), have so far entered into the market (Buiatti, 2013). This unprecedented failure is the result of the non-additive "unintended" interactions of the sequences inserted with the host plant genome, of the interactions of the gene products with the plant metabolism, of those of the GM plant with the agro-ecosystem, the social traditions, and the market itself.

Unfortunately, this is only the top of the iceberg if compared with the damages of industrialization according to the "dogma of infinite growth" of production. As expected, infinite growth has been shown to be impossible but the human response has been to increase the production of completely new "tools" independently from their utility for life, winning new markets through the ever-increasing impact of advertising. It is not by chance that pharmaceutical multinationals and those controlling agriculture are now spending much more for advertising than for the research of useful products. The consequence has been that humans tend now to spend more money for the "must" industrial products than for food.

The effect of the “dogma” on the planet, moreover, has been a frightening acceleration of climate change, a process already forecasted by the Club of Rome in 1972. Jonas wrote: “We have to admit that the problem of how the immense responsibility should be met, which the irresistible scientific technological progress places on the shoulders of both its practitioners and the public which enjoys or suffers from its gifts, is still completely unsolved. Only the beginnings of a new consciousness give us hope that we shall voluntarily impose on us the barriers of responsibility.”
Unfortunately, the response of humans to the failure of infinite material growth was to further abandon the “satisfaction” of real life and to invent a metaphor of the economy, where the exchange of matter is replaced by the exchange of money and the “dogma” of infinite growth of matter is replaced with that of the infinite growth of money. So, while in 1980 the amounts of nominal world GDP and financial assets where respectively ten and twelve trillion dollars, in 2002 the ratio became 33 to 96 and since then the difference kept accelerating with an almost exponential speed, leading in 2007 to an incredible 56 to 196; nowadays the circulating money associated to the exchange of matter is reduced to $1/12^{th}$ of the total.
While in the industrial period a rich and “important” person was somebody who owned and directed manufacturing industries, now the world is governed by financial groups and multinationals; the law of supply and demand has been substituted by the highly unpredictable dynamics of finance exchange, our lives are under the control of a virtual market composed by a complex system of banks, rating agencies, multinationals, etc. Now we know why the “three sisters” controlling agriculture, “Big Pharma” and many other major corporations, invest less for research and production of goods, and increasingly invest their money in financial markets, aiming at profits from stock-gambling, “intellectual property rights”, etc.
For a second time our “satisfaction” has again changed, deriving now from the ownership of money and not anymore from well-being. Within this frame, a powerful person is now somebody who can buy very costly gadgets, obeying to the advertising agencies; a child may be isolated in his school because he does not wear the useless shoes which only the rich can buy, or because he cannot show the last electronic gadget. Even more than before, a person is judged by the number of “up-to-date” and costly “objects” that he owns and not by his human qualities and behaviours. It is not a surprise then, that for instance in Italy during the economic crisis families have been spending less for food and 75% more for gadgets. In H. Jonas terms, we seem to have forgotten both the “tool” and the “grave”, substituted by a mono-thematic capacity of exchanging immaterial “satisfaction-led” virtual money instead of investing in our survival. We are now out also of the “Anthropocene” (Steffen et al. 2007) and in what I call the “Virtualcene”; we forget more and more the real life made of flesh, blood, connections with other humans and with the biosphere and its inhabitants, whose diversity is being lost at a speed a hundred or thousand times faster than in all five earlier extinctions.

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