EDITORIAL

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Evolution Theory as a Conceptual Revolution in Our View of the World

We are witnessing a period in the study of evolution that tends to break the hegemony of neo-Darwinian thinking that during many decades—from the forties of the previous century—dominated the field of evolution solidly and almost unanimously. We are facing a slow but constant accumulation of evidence and theoretical proposals that refute many central concepts of neo-Darwinism: that natural selection is the only mechanism of evolution, that adaptation is, universally, the process that enables the growth of the most favored populations, that the processes of variation and inheritance always respond to the mechanisms of "hard inheritance" and are always located in those units known as genes, excluding all "soft inheritance" processes. As from a couple of decades ago, a whole range of more or less novel explanations and models are appearing on the scene, and is now beginning to shine. One of the traits of this renewal process, ironically, is that Lamarckian explanations are back in favor, even after their being declared false and forgotten by most of the evolutionist community. Their re-emergence is so impressive that we believe it is fair to talk—for the first time since the triumph of the synthetic theory—not about the theory of evolution (identifying it with the Darwinian and synthetic theories) but about theories of evolution. These are a whole group of theoretical propositions that comprise, somewhat like Imre Lakatos' model (1971), a program of scientific research.

This, of course, doesn't constitute a crisis in evolutionary thinking; far from being the manifestation of any sort of uncertainty concerning our comprehension of the evolution process, it speaks of the vigor and growth of research in this field; it modifies many orthodox notions in science, which frequently defend the point of view that, to explain a process or phenomenon in nature (or society), it is necessary to find one and only one theory, one and only one cause, one and only one mechanism. This notion, that permeated evolutionist explanations, is now in crisis too, and in its place we are offered a whole vista of epistemological

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plurality that reflects the complexity of the object-subject-system under study in the case of evolution.

We have mentioned the existence of an epistemological plurality that is dominating the evolutionist program; notwithstanding the vigor with which propositions that differ at least partially with Darwinism are being expressed, it is impossible not to take Darwinian thought into account as the most important historical reference in evolutionism.

It can be said that one of the most powerful engines in the Darwinian theory of evolution can be found in an internal tension between what we could call the revolutionary elements of his theory, and the conservative elements, all of which are expressions of existing contradictions in the society and the intellectual and scientific worlds in which Darwin lived.

Revolutionary elements

When we examine the structure of Darwinian evolutionary arguments, we find a series of points that are what makes this theory a highly revolutionary concept. These points are contained in the proof of the existence of evolution and less so in the theory of natural selection: unification of space and time, conception of the world as a series of transitions, materialism and movement (Muñoz Rubio 2014).

Common descent principle and bio-geographic problems

With this principle, Darwin (1964, 111-126; Ptacek and Hanksion 2009) modifies the whole outlook of eighteenth century science, based on a notion of continuous and inevitable linear progress. As he interprets variations in nature as random events, and as there is more than one possibility for variation and for the selection of variants in every moment of history, as what we observe is a divergence in traits starting from a common ancestor, and as no variation is guaranteed success from the beginning, then great biodiversity becomes understandable, and the complexity of the living world becomes the result of evolution as a creative and inventive process. By means of the principle of the common ancestor we explain the existence of similar structures in related but different organisms. Thus, the processes of morphological unity and difference, and bio-geographical processes become perfectly clear, as we observe them from the point of view of a space-time entity, and interpenetrations between the parts and the whole.

In a bio-geographical analysis we observe important Darwinian revolutionary reflections, as they comprise a brilliant analysis of how historical — that is, temporal — events are projected in the spatial dimension. Before

Darwin, probably no explanation about the geographic distribution of species required any elucidation of the intervention of the time factor; organisms were not considered as entities with a history; that is, that they expressed the accumulation of long time periods. With Darwin, geographical distribution of species is transformed into a superposition and profound imbrication of the temporal scale with the spatial one; the first is deployed on a geological and on an individual and population scale, and the second is unfurled both in terms of individual and population habitat, and of geological and planetary space. All these dimensions interpenetrate each other. Each one is explained as a constituent part of the others. The area occupied by a species is its history, the whole of its preconditions and the preparation for its future conditions, all of them considered as possibilities, not predeterminations.

Darwin (1987 [1856-1858]) rejects that climate factors are the principal cause of variations, (Darwin 1987 [1856-1858], 557-558; 1964, 346-347) and offers satisfactory solutions to problems such as the following: Why do some species from different regions share so many similarities? How is it that geographical barriers cause the generation of different species? (Darwin 2008b, 140-142; 1964, 388-406) Why is it that in places without geographical barriers the differences between species are less pronounced than those observed in the floras of different continents? (Darwin 1964, 348) Why do the floras on distant mountain peaks get to be so similar in spite of the distance between them? (Darwin 2008b, 143-146) Practically all the geographic distribution problems are approached from this comprehensive point of view.

Morphological and embryological evidence of evolution

Any search for explanations of everything in the sciences of life must go through an exercise in integration between form and function, admitting both their interpenetration and their simultaneous differentiation. In *The Origin of Species* Darwin poses a series of questions concerning the possible reasons why there are so many cranial bones, of the bony similarities in the formation of different organs in different animals, of the "strange" relationships between the number of legs and the complexity of the mouth of crustaceans, and of the similarities between the patterns of petals, sepals, stamens and pistils, though they may have very different objectives (Darwin 1964, 437).

By means of elucidations such as these, Darwin accounts for the quantitative-qualitative transformations in parts with a common phylum and onto-genetic origin. A wing and a leg can be very similar in their structures but very different in their functions. A difference like this cannot be understood exclusively as a difference in degree or quantity. Both structures are used for motion, but there is a qualitative difference between walking and flying. Nothing in

animal morphology can be explained if not from the point of view of evolution. Transformation over time can satisfy any doubts concerning different functions.

From the time of his *Essay* (Darwin 2008 [1844]) Darwin stressed the unity of type, referring to the chordates, and emphasized that only by considering this unity as the result of a sequence, a process of evolution, and the process itself, can we understand its contrast with the diversity of forms, something that starts in the embryonic state itself (Darwin 2008b, 181), an idea that is reiterated in *The Origin of Species* (Darwin 1964, 449), giving rise to the discovery that ontogeny recapitulates phylogeny, and this is, in turn, a superposition of time scales, an interpenetration of time scales that have been simultaneously interpenetrated by spatial scales; something like a spatial and temporal hyper-interpenetration. It is, in the second place, the superposition of two temporal scales to form a coherent whole, out of a series of events and changes that evolve from quantity to quality in different time spans. This is a completely revolutionary vision in science. It manages to explain, too, the development of the embryo as a journey through forms and structures observed as dialectic discontinuities and leaps, throughout which those forms and structures appear and disappear, in a process of double denial. The unity of type not only isn't lost, but reaffirmed as a dynamic unity, as movement.

Variations, species, hybridization and the continuity principle

The continuity principle establishes that sudden leaps do not exist in nature, and that all the entities in the universe can arrange themselves along a very fine gradient. This is one of the main foundations of the theory of evolution since Lamarck. A dialectical analysis of this principle leads to the discovery that it contains a contradiction: it stands in the way of understanding the world as a whole when it posits that an essence exists in the universe, and that changes that come about in it can only be quantitative; new qualities are not provided for. Darwin committed that mistake when he analyzed human evolution and instinct (Darwin 2008b, 105-119; 1987, 463-527; 1964, 207-244), or the relationship between human beings and superior animals.[1]

But this same principle becomes a valuable tool to understand the whole when nature itself shows us that those fragmentations and divisions into lots that Cartesianism had forced us to look at, don't really exist. The continuity principle doesn't exclude the existence of qualitative leaps, but it does explain that, alongside these leaps, there are continuous transformations, imperceptible to the senses, or those that do not alter the qualities of the factors in the

1 "Yet, the difference between the mind of a human and that of superior animals, however large it may be, represents a difference in degree, not in class." Darwin (1968 [1871], 105).

system being observed. Changes both in degree and in class can coexist in nature. Darwin offers a good explanation of the combination of these changes with quantitative difference in his analysis of the speciation process that, being a very gradual operation, implies the appearance of numerous variations as a prologue to the formation of species. Darwin finds that it is very difficult to define—following traditional typological methods in biology—when we have a variation, and when a species. Of course, this doesn't apply to all cases, but the number of exceptions is sufficiently significant to arrive at the conclusion that clear cut definitions of species and variation are very hard to arrive at.[2] His all-embracing vision is at odds with the narrow, pre-evolutionist picture. In his drafts for *The Origin of Species* we find a chapter dedicated to this issue (Darwin 1987, 387-462). In one passage he states:

> Apart from the extreme difficulty to decide, in some cases, which forms we should catalogue as species and which as variations, we observe that there is such a faint gradient, that goes from absolute sterility to perfect fertility, that it is very hard to draw a line between the two (Darwin 1987, 388).

With this, Darwin approaches a dialectical vision, and begins to break with the traditional typological conception of taxonomy, that had been dominant at least from the times of Carl Linnaeus.

Paleontological evidence of evolution

Scientific study of the fossils that became available as from the fifteenth century (Rudwick 2008, 201-241), was bereft of any vision of spatial and temporal unity and of a relational point of view. This deficiency is perpetuated during all the time during which a fixist, creationist conception of the world held sway. Darwinism's revolutionary thought, once again, contributed a coherent way out of that problem by means of the dynamic whole of space-time.

Darwin establishes a temporal continuity relationship between the different geological strata, meaning that, in his relational analysis, we get to know events in the history of the Earth; he then establishes the existence of a temporal relationship analogous to that between strata, and between the fossils that can be found in each of these strata, and thus proves that there have been changes in the species that have populated the Earth in other times. Finally, he establishes

2 Post Darwinian development of genetics, ecology and molecular biology, even when they have provided much insight on speciation processes, have encountered many problems, like those described by Darwin himself, to determine clearly the difference between a variation and a species. See, for example, (Ptacek and Hanksion 2009, 177-207).

a correspondence between the ages of the strata and those of the fossils, but unlike any other previous geological or paleontological interpretation, it is presented as a spatial and temporal relationship in flux.

With this analysis of the fossil record Darwin achieves an innovation in scientific thinking: from a simple spatial distribution of artefacts, we move on to a spatial and temporal distribution of ancient organisms. From a description of mysterious objects we move on to a coherent, materialist and real explanation of processes and activities that become comprehensible in the spatial and temporal complex. The Darwinian direction towards integrative, interdisciplinary and totalizing thought is unmistakable.

Conservative elements

However, in working out the theoretical explanation of the phenomenon whose real existence is already proved by biological evolution, Darwin moves away from this highly dynamic concept contained in the evidence we mentioned previously. Without abandoning his materialist conception, Darwin resorts to a series of analytical categories and explanations that originated in political economy.

It is important that this component of evolution theory be treated in certain detail, because Darwin cannot detach himself completely from a misleading and fetishized world-view, entrapped by the fundamental categories of political economy: private property, commodities, money, overpopulation, scarcity, territoriality, benefit, success, selfishness. The principal problem in all this is that Darwin incurs in an ideological fallacy when he incorporates these elements into the central part of his theory; that is, in thinking that the behavior of individuals all over the world is analogous to that of certain human beings living in and off the production-circulation-consumption relationships that are characteristic of capitalism. In other words, he seems to think that these relationships and categories are determined by nature, and therefore eternal and immutable. It is, once again in the history of science, a process that involves imposing a preconceived idea upon the reality of the material world; an inversion of the relationship between the knowing subject and the object or system of his study. The knowing subject, in this process, imagines a situation in which perceived reality is stripped of its historical explanation and conceived as if it were the sum total of reality, and as if it were made up of eternal elements. This, that in general leads to the shaping of what is sometimes called “false consciences”, is an inconsistent element within the Darwinian theory, as the theory itself is one of continuous and deep change, but it is explained in terms of categories and processes that are deemed to be constant and unchangeable.

One of these elements that has been most comprehensively examined is the

influence of Thomas Malthus' demographic theory. As is well known, Darwin found in the apparent contradiction between population and resources an explanation for the evolutionary process by means of natural selection. Briefly summarized, the Malthusian-Darwinian explanation would read as follows:

1. In the living world, the capacity for growth of populations is much greater than that of resources for their subsistence.
2. This creates a situation of permanent scarcity, more pronounced in some moments than in others, but perpetual.
3. This situation necessarily generates a struggle for the few resources available, and is explained as a "struggle for existence".
4. The individuals best suited for this struggle are the victors, as they are better adapted to the hostile conditions of the environment, and are therefore capable of generating more offspring, in contrast with the weaker and maladapted individuals, who will tend to disappear.

Analysis and debate over Malthus' influence on Darwin are extensive (Schweber 1977; 1980; Greene 1977; Todes 1989; Young 1969; 1971; 1973; Muñoz Rubio 1999). The issue is hardly trivial, as Darwin himself said that the reading of Malthus enabled him to conceive his theory of natural selection. It is interesting to note that in his autobiography Darwin mentions that he embarked on that reading "for entertainment" (Darwin 1958 [1892], 42), and for this reason the role played by the British demographer's theory in that of evolution has tended to be minimized on occasion.

It seems highly doubtful, to say the least, that Darwin really read that long and tedious text (Malthus 1971) simply for entertainment, perhaps in a moment of boredom. What really explains the inclusion of Malthusian elements in the Darwinian theory is that Darwin felt strongly identified with Malthus' world view, with the idea that scarcity is permanent, that competitiveness and a warlike and selfish spirit are natural traits in any organism. In fact, it is the same vision, and even though it has been hugely fertile over many decades, that cannot mask its ideological nature (Young 1969; 1971; 1973).

The other influence contributed by political economy comes from Adam Smith (1954 [1776-1778]). Although it isn't explicit in Darwin's work, it cannot be denied. This influence is clear in the Darwinian concept of progress. According to him, who admits from the start that evolution is a progressive process "towards perfection", this progress must be measured as a general trend towards the division of functions in evolution. Adam Smith wrote in *The Wealth of Nations* about a natural tendency towards an increase in the productivity of labor, that has its expression in manufacturing processes. The greater the division of

functions in a manufacturing process of a given article, the greater the speed with which it will be made, and obviously the material wealth will increase (Smith 1954 [1776-1778], vol. I, 4-19), so that, according to Smith, labor invested in manufacturing would be not only the most natural labor possible, as it would correspond with the natural human tendency to trade and barter (and the greater the volume of production, the greater the trade).

Darwin adopts this notion of progress. Even though he doesn't mention Smith explicitly, but refers to von Baer, the origin and transmission of such a notion are obviously Smith's (Darwin 1981 [1871], vol. I, 211). In the world of living beings there exists this tendency to increase the division, or specialization, of functions. It can be observed on two levels: individual, and on a biological community scale. In the first case, we observe the tendency of species to evolve in such a way that individuals develop specialized parts to carry out one, and just one, function; or, at least, that this part should be distinguishable from other body parts. This becomes clear when we analyze the structure of animals and plants known as "superior", in which this "superiority" resides precisely in this division of functions. The other level would involve the division of functions among different species that live in a given geographical area (many of which could possess a certain specialization according to the first criterion). The more divided functions are within a biological community, all the more efficient would be the division of the scarce resources necessary for survival, thus temporarily alleviating the effects of natural selection and the struggle for survival, although this respite would be temporary given the inevitability of the Malthusian law.

Again, the identification of Darwin with the principles of the bourgeois vision, with its competitive and individualist *ethos*, is quite evident.

The third ideological element we find in Darwin is his theory of sexual selection. Here, Darwin explains that it is a subordinate process to, and less severe than natural selection, and that it consists of the struggle of the males for the possession of the females, so that the fittest individuals of both sexes are selected within a given population (Darwin 1964, 87-90). In applying this theory to humans, Darwin naturalizes the active, enterprising, aggressive character of males, and the fundamentally passive and reserved nature of females (Darwin 1981, vol. I, Part II, 253-320; vol. II, Part II, 316-384). This is accompanied by the naturalization of the man/woman, and masculine/feminine binarities; in other words, the assigning of a naturally determined sexual function, emerging from the male/female binarity, to suggest the fundamentally reproductive function of sexuality. All this is far from representing a natural attribute of one sex or the other, but rather an ideological extrapolation of the dominant sexual behavior in the patriarchal Victorian society in which Darwin lived.

The previous paragraphs represent a tight summary of a number of points that—despite having exhibited a truly great heuristic capacity—have survived over the one hundred fifty years since the publication of *The Origin of Species* considered as a sort of domination doctrine, rather than a scientific truth or an approach to such a truth. The triumph of neo-Darwinian visions, that explain evolution exclusively in terms of adaptation, a product of natural selection, itself caused by genetic variability, led to reinforcing the naturalization of these conceptions. Advances in genetics, molecular biology and psychology, that occurred in recent decades, were used in many cases to bolster these ideological-patriarchal-individualist principles.

Neo-Darwinism, also known as "modern synthesis", resulting from the fusion of Darwin's theory of natural selection with Mendelian genetics, represented a decisive impulse in the study of biological evolution, and a formidable conceptual and practical achievement in scientific production.

However, we also behold the development of certain lines of study and research marked by considerable reductionism and remarkable vulgarity, especially in all that concerns social behavior of animals, including humans, of course. These lines express clear genocentrism, assigning a genetic base to behavior and naturalizing, once again, values, principles and practices that are distinctive of patriarchal societies and capitalism. Among the fields of knowledge thus developed it is worthwhile mentioning ethology, driven by Konrad Lorenz and Niko Tinbergen (Lorenz 1982 [1963]; Lorenz 1986; Tinbergen 1975 [1951])[3] in the fifties and sixties of the last century; socio-biology, defended by Edward O. Wilson (1975; 1978) and Richard Dawkins (1976), that had its heyday after 1975; and the most recent, evolutionary psychology, from the early nineties to the present, and whose major proponents are Steve Pinker, David Buss, Randy Thornhill, Leda Cosmides, Jerome Barkow and James Tooby, among others (Barkow, Cosmides and Tooby 1995; Thornhill and Palmer 2006). These cases deserve special attention because—due to the disproportionate weight of ideological elements—it is possible to talk about real pseudo-sciences of biological determinism.

The struggle of reductionism against totalizing visions

This rapid description of the major points that cause tension within Darwinist theory is important because it is one of the central factors that has enabled the development of the evolutionist program. Objections to certain contemporaneous expressions concerning the ideology inserted in evolutionism have been

3 An autor who shows with great eloquence the coincidences between ethology and sociobiology is Lerner (1992).

formulated in many ways. We understand contemporaneous as the evolutionary biology that developed as from 1953 when J. Watson and F. Crick (1953a; 1953b) determined the three-dimensional structure of nucleic acids.

Reductionist expressions in evolutionism are marked by a fetishization (in the Marxist sense of the term) of the units of transmission of genetic information, and by a "neo-preformist" conception of the growth of organisms.

Considering the first point, so called "modern synthesis"—or neo-Darwinian theory of evolution—emerges from the need to understand the precise mechanisms for the transmission of genetic information and variations in this information. In this sense, the work of G. Mendel (1866), is of fundamental importance, as it explains precisely what Darwin never managed to do: How is the information transmitted from one generation to the next?

The principal shortcoming of these "genocentric" explanations is that, on the one part, they conceive these units of genetic transmission as entities that can dispense with all that surrounds them to carry out their functions. That is, nucleic acids and the genes they contain can exist on their own; they do not require any sort of relationship to exist and function, they explain themselves. The highlight of this explanation can be found in the so-called "Central Dogma of Molecular Biology", proposed by Crick in 1970 in which the transmission of information from DNA to RNA, and thence to a protein is explained as a universal mechanism; but furthermore, it is proposed that there exists a permanent capacity of DNA to self-replicate, to exist on its own (Crick 1970). This is the quintessence of fetishist and fetishized conceptions of the world, that tend to draw a veil that prevents us from knowing the overall picture of the relationships that exist in any phenomenon, and which only take into account that which is simple appearance, considering it as the essence, which is a consistent deficiency of the bourgeois conception of the world.

In using all this to deny external influences on the molecules in the transmission and variation of information, it is accepted that the "essential" units are encapsulated, kept apart from their environment. This is a deficiency intimately linked to what we describe above, because the organism is conceived as totally designed in its genome, that genomes are the organism itself, previously formed. This means that, setting aside all types of relationships, genomes pre-exist the environmental conditions in which they are destined to introduce themselves as individuals, without any fundamental change between the sum of genetic codifications and the individual as such, that this individual is the quantitative projection of his/her genome. If (according to the pan-selectionist conception typical of modern synthesis) the individual is adequately adapted, or not, to the conditions of his/her existence, and therefore capable or not of surviving or of leaving a numerous offspring, this will be determined by those

same conditions, that will be unilaterally imposed on the organism, in total absence of any effective link between them, because organism and environment are on separate paths.

Here we are looking at something more than the influence of René Descartes on evolutionism. It isn't about the work of one isolated person influencing others, it isn't the interaction of theories in the absence of subjects, but the manifestation of a persistent contradiction in bourgeois culture, that seeks and finds dynamic explanations of the world, only to deny them as soon as they cannot be explained according to the categories and values of market economy and patriarchal philosophy, falsely deemed to be natural, and not historical, principles.

In this way, reductionist evolutionism, in separating the organism from its environment, in conceiving individuals or genes as the unit of evolution, is reproducing the hoary custom of trying to understand parts in isolation from the whole, and the whole as the sum of its parts; in other words, the whole as the quantitatively augmented expression of the essential property of the part (Descartes 1995 [1647]; (1996) [1637]). This means a rejection of the possibility that, over time, new characteristics may appear in systems subject to evolution. It also reproduces the old habit of thinking about cause-effect relationships as unitary links, in which the effect is caused by one, and only one, cause, that the effect is produced inevitably after the cause, and that it is always the same. Both these conceptions are rooted in the mechanism of classical physics, and they are excellent and fruitful when it comes to solving the problems of simple, inanimate bodies, but limited when applied to the study of complex systems like organisms and their space-time relationships,

Countering this type of approaches, a trend has been developing—that we could call "counter-hegemonic trend"—that stresses the relationships of living beings rather than their essences. In other words, according to this trend, the study of living beings should be centered on the assessment of the whole, instead of on the "master molecules", whose mastery or authority is, in fact, in doubt.

A comprehensive review of all these works would require much more space than is available here, but we can quote the most relevant examples and some of their variants.

The works of A. Oparin on the origin of life are worth mentioning, as they are among the first that opposed reductionism in biology (Oparin 1972 [1938]; 1953 [1938]; 1973; 1978). Oparin rejects that this process might have been the result of a merely mechanical addition, in which diverse molecular components assembled spontaneously to form a molecule containing the capacity to transmit information, and thus constituting "the essence of life". He considers this explanation insufficient, and substitutes it with a model that contemplates the

integration of multimolecular complexes (he calls them "co-pooled") which act in systems existing in an aqueous medium, but separated from it after the fashion of oil and water. These multimolecular systems with phase separation are, according to Oparin, the most appropriate structures to achieve a totalizing interaction between all the existing elements. The result is not the emergence of one or two molecules with a higher hierarchy over the others (DNA and RNA), but rather a whole group of elements that inter-relate, generating a succession of qualitative leaps.

This is what happens when the naked molecules that exist in the aqueous medium evolve into primitive multi-molecular systems—the probionts, and from there to the eubionts—that is, the first organisms. In all these stages, the quantitative increase of the existing molecules and their interactions lead to the acquisition of certain forms of organization, with principles and rules appropriate to that stage in evolution, which cannot be understood in terms of the rules of the previous level or state. It involves a succession of dialectic negations and self-negations in which new features appear, instead of the simple quantitative expansion conceived as such by philosophical mechanism.

Oparin's criticism to this point of view departs from the demonstration that, without relationships, no entity can develop any function at all, or worse, it doesn't even make any sense to think about it, because its existence makes no sense (just as it makes no sense to think about a whole human being in permanent isolation from all the others). Nucleic acids and their genes require an environment in which their existence makes sense, but if this is so the dominance of this molecule passes from the molecule itself to the process as a whole. This is one of Oparin's most important contributions. This thesis contained explicit or implicitly in his work, will be expressed by other evolutionists in later decades, with more or less independence from his studies.

There are other more up to date expressions of this vision of the whole picture. Lynn Margulis' work on the so-called "Serial Endosymbiotic Theory" (Margulis 1971; 1993; 1997), lays the foundation for the comprehension of evolution, not according to permanent competition and hostility, but to cooperation, that offers one of its clearest examples in the origin of the eukaryotic cell.

Susan Oyama and her Theory of System Development, in which she refutes the contention that the "natural" and the "learned" lead separate existences, and states that both categories should be scrapped, and instead considers integral and inclusive development as the central element in the process of life. Oyama coined the concept of "constructive interaction" to refer to a constant introjection of factors and processes from certain entities in an organism into others, which constitutes a clear dialectical proposition in which the interactions between opposites reach a level that surpasses that of simple, casual and mutual

action, to become a form of construction of a whole living system, which implies integration with its environment (Oyama, Griffiths and Gray 2001; Oyama 2000; 2002).

In mentioning this mode of evolutionary approach, we must stress the work of Richard Levins and Richard Lewontin, in which they apply explicitly and deliberately the dialectical principles taken from Friedrich Engels and Karl Marx (and their Hegelian roots), especially those of the former (Levins and Lewontin 1985; 2007; Lewontin 2000; Levins 2007) Thus, they observe the living world and its evolution from a point of view that opposes reductionism, and proposes the construction of a dialectical vision that contains several dialectical denials and improvements: in the first place, it overcomes and denies reductionism in a relational vision; but, also, it overcomes and denies the relational conception as an "interactionist" notion. In its place, these authors present it as a world of *interpenetrations*; in other words a simultaneous process in which the affirmation of the existence and functions of one component of the living world that we will call "A" (that might be anything from a gene to an ecosystem), that can only be understood in terms of the existence of its counterpart, that is, the component or components that are the negation (ontologically speaking) of "A"; of all those that are "not-A" but, being its negation, its being Other, are its relationality, are its being contained in the Other, being the Other at the same time as denying it. The parts are interpenetrated with themselves and with the whole, thus resolving the ancient problem of whether the whole is the numerical equivalent of the sum of the parts, showing that the whole of simple inanimate systems is not the same as the whole of complex systems like living beings.

Levins and Lewontin show how the concept of interpenetration also leads us to understand how mistaken the adaptationist program really is, when it posits that adaptations are universal consequences of evolution. This notion is rooted in a conception of evolution in which organisms and the environment lead separate existences. Levins and Lewontin criticize this. The latter establishes that what really happens is that a co-construction is generated, both in the organism and the environment, in which both elements are profoundly imbricated; the organism selects its environments, just as these select organisms; the active role of evolution cannot be limited to the environment, leaving the organism in the role of passive object (Lewontin 1983). It is a subject-object relationship in which the roles of one and the other are exchanged and alternated, rejecting the idea that there must be one side of the relationship that is permanently adapting to what the other side—described as always active—is instructing it to do. Furthermore, this thesis of Lewontin's is a massive argument against strict adaptationism because it denies that there may be pre-existences in nature. Adaptationism avers implicitly that organisms that survive natural selection do

so because they are capable of resolving problems, problems that pre-exist themselves, as if there were a directionality in evolution in which life conditions are established beforehand, or "decided" so that organisms may express the instructions with which they were previously equipped to adapt to an environment whose existence was inexorable.[4]

Finally, as one of the more recent contributions to the criticism of reductionism, we have the work of Eva Jablonka in defense of neo-Lamarckian conceptions (Jablonka and Lamb 1995; 2005; Gissis and Jablonka 2011). (See also Jablonka's article in this issue of *INTERdisciplina*). According to Jablonka's model, neo-Darwinian theses began to crack when they proved incapable of showing the universality of "hard" inheritance and random variation, true pillars of modern synthesis. Without denying the existence of these forms of variation and inheritance, she posits the parallel and/or simultaneous existence of other processes. Some of them, principally epigenetic processes, are still linked to genomes, but autonomized from them and, on the other hand, mediated and directed by environmental conditions. Other evolutionary processes are frankly independent from genomes, as in the case of behavioral, symbolical or cultural evolution. Inheritance here has separated totally from the DNA-RNA-Protein sequence.

The consequences of this Lamarckian resurrection are of course unpredictable. What is clear is that it represents a radical change in the theory of evolution. A change that is seriously undermining many foundations of neo-Darwinian theory. The existence of two theories with simultaneous validity is something that hadn't happened before in the field of biological evolution. It's true that Darwin himself admitted frequently that his theory of natural selection might not be the only valid one, and that cases might be found in which Lamarckian principles could work, but he thought of them as exceptional cases and situations. In the subsequent struggle between Lamarckians and Darwinians, it was the latter who proclaimed that there was only one valid theory, the neo-Darwinian one. The manner of transmission of information was basically the one discovered by G. Mendel, and the mechanism of evolution was based on natural selection, with its necessary adaptations. The rest of the story is marked by the rivalry between the two theories, in which the Lamarckians inevitably lost the battle, because at the time it was quite impossible to dislodge neo-Darwinism as the theory of evolution.

But Jablonka's research and postulates tell a different story: the existence of

4 For an analysis of adaptationism, consult the following: (Williams 1966; Lewontin 1985; Lewontin 1978; Gould and Lewontin 1979; Gould and Vrba 1982; Lewens 2009; Sober 1996; Kimura 1983; Kimura 1992).

two theories of evolution that had been deemed mutually incompatible, were really quite complementary, as they helped reinforce the evolutionary research program. And they also make it more fruitful; they increase its heuristic capability. Above all, what Jablonka shows is that, when studying complex systems like living beings, the multiplicity of paths, planes, directions of processes, space-time inter-penetration, and organism-environment unity, are so constant and conclusive, that it makes no sense to continue attempting monist explanations and one-to-one cause-effect relations.

Finally, it is worth mentioning that this type of contribution against reductionism is undermining the foundations of what we could call the genocentric, or hard inheritance, model, as the universal mechanism for the transmission of information. Concretely, the universal validity of the DNA-RNA-Protein models of final flow of information are called into question. The same can be said for the genetic determination models based on relations of the one gene-one protein type, the genotype-phenotype relations in which one and the other are fragmented into independent parts that enable the fragmented transmission of information in a system that is always closed, always isolated.

The case of the Central Dogma of Biology we already mentioned is interesting because it shows how reductionist conceptions of the world, with their visible class imprint, are part of the construction of scientific models that are apparently disconnected or independent from ideological, economic or political interests, but that sooner or later are adopted by those with unmistakable involvements of this type. We refer, for example, to the way in which advocates of the agro-biotechnology industry uncritically defend the traditional conception of gene and the Central Dogma of molecular biology, ignoring the growing doubts being expressed about its universal validity.

Towards the construction of a bio-cultural evolution theory

New developments in evolutionary biology are enabling the construction of a bridge between biological and social sciences. The search for such a bridge is nothing new, as multidisciplinary projects that link aspects of both fields have been in place for some time. Publications like *Human Ecology*, which started publication in 1974, focus precisely on the biological implications of social dynamics and, at the same time, on the social effects derived from transformations in fauna and flora. Cultural materialism and ecological anthropology, from the seventies onwards, and even before, underlined the importance of describing in detail the ecological effects of cultural practices. Ethnobiology, medical anthropology and bio-semiotics are other fields whose study object fuses the social and biological spheres. Irrespective of point of view, however, the processes

involved in the emergence of bio-cultural evolution as a research field, as well as the different theoretical and methodological approaches with which this research is undertaken, require a much longer and detailed examination than can be carried out in this editorial comment. The following lines are limited to discussing recent stances concerning the person/organism dichotomy, on the one part, and reflect about the niche construction theory—at least, in what concerns human beings—in social sciences, particularly anthropology.

Selectionist interpretations of human culture were already present in Charles Darwin's *The Origin of Man,* and provided structure for so-called social Darwinism towards the end of the nineteenth century and the beginning of the twentieth. In fact, from the thirties of the previous century anthropologists like Franz Boas detected a racist undercurrent in these interpretations and rejected explanations of culture from a biological perspective. The independence of cultural dynamics from biological evolution has been, since then, an integrating principle in anthropology (Ingold, 2004; Schultz, 2014; also see Schultz in this edition of *INTERdisciplina* on page 131). It seems odd, then, that now anthropologists (like Ingold and Schultz) should be theorizing on bio-cultural (or biosocial) evolution, from the point of departure of some novel developments in evolutionary biology. What is new in bridge-building between the sciences of life and social studies is not the desire to build them, but in the sort of links that are emerging.

Darwin's theory created a radical new place for humans in nature. While eighteenth century scientists surmised a difference in type between the cognitive capacities of humans and other animals, Darwin proposed that perceived differences were simply of degree. If, in the eighteenth century, the difference between the "savage" and the "civilized" could be explained in terms of uneven development within the same type—the former still need to develop their intellectual potential before they can catch up with the latter–, for Darwin the separation between the two could be very great, but with infinite gradations between them. The difference between the most primitive savage and the most intelligent simian, although it is even greater, exhibits the same cascade of gradations. Anyway, the mental capacity of the former, with all his/her humanity, is closer to superior primates than that of a civilized European. Darwin's prose in the third chapter of *The Descent of Man* leaves little doubt on this matter.

This perspective served colonialist projects aimed at exercising tutelage over peoples deemed savages and, as a justifying argument, civilizing them. But this didn't mean simply educating them, but identifying and segregating the most promising members of the colonized communities and promote that these select few couple and have children because, according to the accepted notion, cognitive capacities are inherited. For example, Darwinian mathematician Karl

Pearson (1904), one of the founders of the journal *Biometrika,* thought that a public education system for the British Empire would be a major influence, over generations, in improving the intelligence of the King's subjects. This result would come about, he argued, not only as a result of teaching, but also as a consequence of the socializing role of the schools. The excesses of the eugenics programs and the emergence of national liberation movements contributed to the demise, after the Second World War, of the approach based on differences in degree of the cognitive capacities among superior primates, human "savages" and "civilized" individuals. The conception that human cognition is of a different type from animal cognition regained ascendancy.

However, as Ingold comments (2004), the rejection of racist arguments, even when it was a fair and necessary achievement, resulted in a conceptual impasse in anthropology: it is accepted that biological evolution served to account for the emergence of humans from their primate ancestry; but, once *Homo sapiens* populated the Earth, behavioral and cognitive variations were circumscribed to the field of culture. Biology relinquished its place to history. Evolution of Humanity, therefore, is conceived in two separate stages: one in which evolution by natural selection and modification of descendants determines the scaffolding and organic—morpho-physiological—substrate that underpins the superior mental capacities that all humans possess or can develop, and another stage in which these capacities are deployed in cultural practices and constructions. Once the issue had been stated thus, the threshold between the first and second stages became the recipient of special attention as a study object. However, it is an object to which we no longer have access, given that it has receded into a distant past, and all that is left to us is to investigate a present day surrogate and identify or reveal those (essential) qualities that, plausibly, might be projected into the past, as if they too were characteristics of that threshold moment. Many studies about hunter-gatherer groups of the present are performed with this objective in mind: considered with some irony, it could be said that anthropology has its own "model organisms".

Keeping the duality of the cultural sphere *versus* the biological is useful for marking out disciplinary fields, but if what we really pursue is an integral understanding of human life, it generates more problems than it solves. Human beings are both social and biological: persons and organisms. Instead of retaining the dichotomy, wouldn't it be better to generate another concept of person that embraces and fuses experiential and ontogenic development? This type of change in perspective places the person in a field of social interaction—that is, of inter-subjective relationships, be they face-to-face or mediated by cultural devices—and conceives him/her as an entity made up of diverse trajectories (psychological, emotional, physiological, communicative, socializing) leading

to maturation and growth. The person becomes, then, a developing node, within a dynamic relational field, that changes in sync with the development of the node (Ingold 2000, 4).

Niche construction

The concerted deployment of the living being and its environment occupies a central role in the theory of niche construction (Laland *et al.* 2000; Odling-Smee *et al.* 2003; Kendall *et al.* 2011; O'Brien and Laland 2012), a theory linked to the evolution of development. According to this line of reasoning, the environment is no longer a mere external instance that influences the life cycle of the organism, nor a medium made up of biotic and abiotic factors in which that organism lives. It is posited that the activities of the organism contribute to modelling the environment in which it lives; that is, it participates in the construction of its own environment. Now, in the interpretation of the so-called modern synthesis, the environment establishes the selective pressures that limit or enable the reproduction and survival of the organism in question; the interesting part, from the perspective of niche construction, is that when it modifies and participates in the construction of its environment, the organism also modifies the selective pressures that are exerted upon it. Furthermore, the constructed niche is inherited by later generations, like a sort of patrimony that is bestowed upon a certain group of descendants. This ecological inheritance—as it is known—complements the genetic inheritance.

Concerning *Homo sapiens*, activities directed at building the human environment comprise cultural practices related to the production of food, clothes and shelter, but they also include activities linked to learning and teaching, symbolic production and the establishment of institutions and norms. Therefore, various inheritances are operating: that which concerns genetic transmission, the inheritance of the anthropogenic landscape and its resources, and the legacy of symbolic culture (figure 1 shows a diagram of this).[5] Given its conceptual architecture, niche construction theory can contribute to the creation of an interdisciplinary research field in which social and biological scientists converge. This does not mean, however, that this space already exists and that we only have to occupy it; we must stress possible inter-theoretical links between this conceptualization of the niche and theories that have emerged from social

5 Emily Schultz's contribution to this issue of *INTERdisciplina* points out that in later formulations of the theory, cultural inheritance was included in ecological inheritance. She stresses the convenience, from the point of view of social sciences, of maintaining a three-sided conception of inheritance, as is shown in Figure 1.

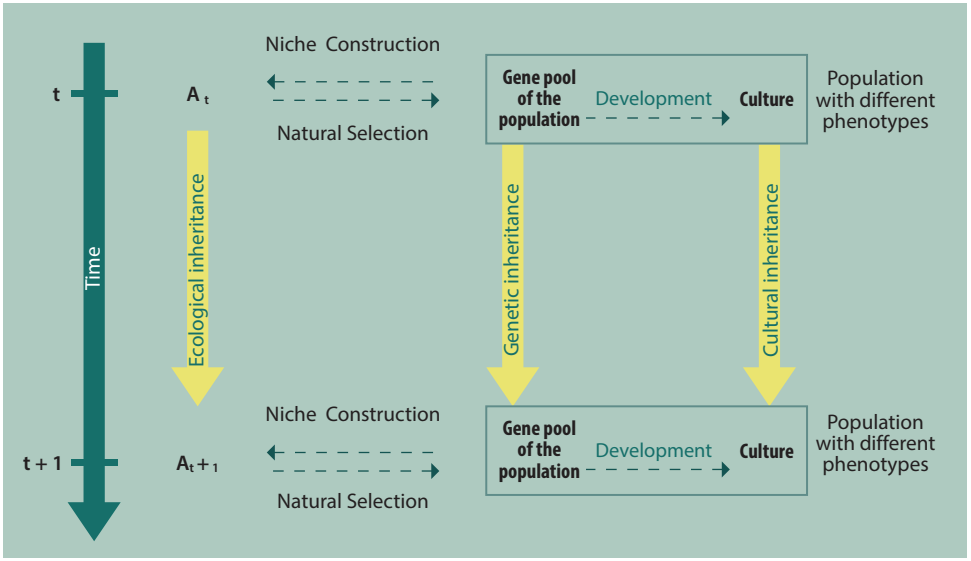

Figure 1. Prepared on the basis of Laland *et al*., (2000). A_t and A_{t+1} correspond, respectively, with the environment in time t, and the environment in time t + 1.

sciences, thus determining a more robust conceptual framework to guide interdisciplinary work.

O'Brien and Laland (2012) discuss the pertinence of the niche construction theory *vis à vis* the origins of agriculture and cattle raising. They highlight diverse models of niche construction and their effects upon cultural/social and biological aspects of human populations. It could well be the case, they argue, that the modified set of selective pressures could have a bearing on one aspect or the other, or maybe on both simultaneously. For example, the modification of human habitat may give rise to illnesses that were not frequent previously. Maybe a cultural innovation, let's say, the discovery of an effective medicine, is enough to counteract the illnesses that emerged from the structural change of the anthropogenic landscape, in such a way that this selective pressure doesn't affect the biological constitution of the population. Thus, the effect of niche construction only causes a cultural change. But it could also happen that the appropriate cultural innovation doesn't occur, or that it is insufficient, in such a way that the presence of this or that illness has effects on the frequency of genes in the human population. With the advent of several generations, one or several genes that confer resistance to the illness in question become fixed among a majority of the members of the group.

What are really interesting about O'Brien and Laland (2012) are some of the

comments made by a group of guest readers, many of them extracted from the social sciences.[6] Here is where the possibilities of interdisciplinary bridges can be perceived better. Some of these commenting readers (Kim Sterelny, for example) point out that the examples cited in the article (resistance to lactose among milk-consuming shepherds, resistance to malaria among peasants in Western Africa) illustrate cases in which the connections between cultural change, phenotypic change and genotypic change are more or less direct and non-problematic. The effects on populations and genotypes of many other cultural innovations are not so clear, although the modification that these caused in selective pressures exerted on the human group in question could be quite evident (think in terms of clothing). On the other hand, the examples presented by O'Brien and Laland do not take into account the role played by entities that regulate collective labor (states, religious organizations, etc.), or resistance evoked against their dictums, in the construction of the anthropogenic environment, in the preservation or alteration of cultural traditions and in the invention of devices. It is necessary, therefore, that the theory presented should incorporate more possibilities of the human agency than those included in mere environmental engineering (comment by Agustín Fuentes). It would be desirable to give more weight to the effects of the division of labor, as well as conflicts between social groups with diverging interests.

Among the social theories proposed as complementary and enriching to the niche construction theory, the actor network theory described by Bruno Latour (Hodder 2010; Schultz 2014) is worth mentioning. But we must highlight that the link is proposed in an exploratory sense, to the extent of subordinating it to some conceptions of the social scientist in question. Thus, from the field of archaeology, Hodder (2010) develops a proposal concerning material culture, which concedes the nature of agency to objects. What he wants to bring to the fore is how humans depend on objects, objects depend on other objects, objects depend on humans, and humans depend on other humans. He calls all this skein of relationships *entanglement*, and he avers that this conceptual framework can embrace and accommodate the theories of niche construction and actor network. Schultz (2014) offers a similar reasoning and incorporates the links these theories exhibit with the dynamic development systems approach.

Apart from the already mentioned, there are other possibilities, which seem to have been explored very little (at least concerning their ties to niche construction). Henri Lefebvre's construction of space (1991) is one of them,

6 The article was published in *Current Anthropology*. This journal makes a habit of including, together with the principal article, the comments on the text formulated by a group of guest readers.

although the authors of this editorial comment were unable to find works that link these two conceptions during their bibliographic search. Anyway, instances of social space production described by Lefebvre could well be considered instances of human niche construction. Perhaps the difficulty in finding authors who propose this link can be traced to the fact that Lefebvre focuses eminently on the development of cities, while Odling-Smee and his colleagues haven't stressed the urban environment when referring to *Homo sapiens*. Notwithstanding, Radding (2012) describes in detail—from the point of view of the production of space—the development of agave culture in the North of Mexico, and this account (which is not centered on cities) is well suited to the pattern of niche construction, although the authoress doesn't underline this fact.

If the suggested link is plausible, then the pattern created by Odling-Smee and his colleagues is linked to Marxism by way of Lefebvre. It may not be the only connection, nor the best one, with this great conglomerate of research programs that have emerged from Marx's pen. Anyway, the tie between Marxism and niche construction is worth exploring, as it could offer us a powerful conceptual device for understanding biosocial evolution.

Conclusion

We have produced a very general review of some of the aspects we consider central to establishing evolutionism as a truly global conception of the world; we could consider it an attitude before the world. Just as Copernicus' contribution radically changed the manner in which we locate humans in the Universe, similarly evolutionism, headed by Lamarck and Darwin, has managed to banish from human thought and action the idea of fixity in time, of eternity understood as absence of change. This revolution could achieve an even greater scope, free or almost free of mystification and fetishism. If this has not happened yet, it is due to the presence of the conservative elements already mentioned, who still tie evolutionism (ever more weakly) to an obsessive (but unreal) conception of permanence, absence of movement; these same elements would like to anchor evolution itself to static forms of existence of matter, explain it ultimately as that which denies it: fixity. But at the same time the persistence of these elements is what (maybe involuntarily) has played a partial role as engine for evolutionism, given that it has not only generated, but also carries in itself the development of its opposite: the dynamic materialist conception. What is rich and enriching in the evolutionist attitude can be seen as the unity of this struggle between the ideological and hegemonic *versus* the revolutionary and counter-hegemonic. Its movement and internal contradictions are at once a reflection and a base for contradictions and movements in broader conceptions, not only

in the natural, but also in the social sciences, philosophy, everyday life, the gamut of social relations; in a single word, culture. If there is a scientific theory that condenses this strong interpretation of all these complex components of the human essence, it is evolution theory. There lies its power and its unlimited explanatory and heuristic capacity. id

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