
Aldo Fasolo Editor
The Theory of Evolution and Its Impact
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Introduction: The Sand Walk (on the Darwin's Steps)

Aldo Fasolo

Abstract To understand the status of Theory of Evolution, highly multidisciplinary approaches are needed. Thus, the book moves from the historical and philosophical roots, to follow a long and winding road, passing from anthropology, to linguistics, genetics, developmental biology, neuroscience, cognitive studies, to find a final lap on today theories. The inescapable conclusion, quoting the contribution of the philosopher Michael Ruse, is "that in fifty years or a hundred years we will still have the theory of the Origin around. Great, precisely because it does not stand still, but remakes itself and grows and changes by virtue of the fact that it gives such a terrific foundation. Is Darwinism past its sell-by date? Not by a long chalk yet!"

Year 2009 celebrated the triumph of Darwin as global superstar, spinning from the pop icon to the actual understanding to what make him a great innovator, able to give a turn to the whole modern culture. After such a deluge of books, conferences, reviews, gadgets, what is today our vision on theory of Evolution and its Impact? This was exactly the goal of an inter-academy meeting held in Torino (May 27–29, 2010) involving the *Accademia delle Scienze di Torino*, the *Accademia Nazionale dei Lincei* and the *Berlin-Brandenburgische Akademie der Wissenschaften*.

The preliminary question was obviously if we needed another meeting on such a topic. In the commentary about a book recently published on the first 150 years since Darwin [1], reporting the dramatic expansion of the applications of evolutionary science in recent years and the wages in terms of confirmations and extensions, David P. Mindell closes saying: "Does all this activity mean evolution has lost its ability to excite fear and opposition?" Not yet. As the root for natural explanations of human origins . . . and ultimate impetus for human moral behaviour and values, evolution remains the disturbing discovery.

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This is even more relevant, if we step from biological sciences to humanities. Accordingly, the goal of the meeting was to achieve a broad analysis of the impact, pinpointing on a few specific, but paradigmatic topics. Even the place was well tempered, since Torino was in Italy one the main diffusion spot for Darwinian thought and work, both from the academic and editorial point of view.

The present book collects essentially contributions (except for Rossi' and Pievani's ones) from the meeting, mixing styles, arguments, subjects. This kind of inter-disciplinary approach may appear erratic, but it conveys flashes of light on the changing scenarios where the theory of evolution is moving. It is on line with the idea to reopen the file of the Two Cultures, looking at shared problems, which are not really the Third Culture invoked by Charles Percy Snow half a century ago, but they can foster it, at least in such a pivotal domain as evolution.

1 Roots and Buds of Evolutionary Theory

In history of science, for instance, notwithstanding a few crucial contributions, the intellectual credits of pre-darwinian authors remain rather bad known. "The almost total lack of interest for the state of affairs in the publishing industry of the period under consideration, and the total lack of interest for what books, dictionaries, encyclopaedias actually said, made us blind to major debates of great significance for the history of the life sciences at European level during the early decades of the nineteenth century. Thus the reconstruction of the ways in which Lamarck was read, admired, criticized or denounced might be considered a mile stone of the modern reappraisal of history of evolutionary thought." Thus Pietro Corsi is crunching the cultural background before and around Darwin, focussing on the set of easy assumptions concerning the place and reputation of Lamarck within the French natural history community of the early decades of the nineteenth century. Such visions acted as true *Idola tribus*, preventing research and limiting in considerable ways our understanding of the complex intellectual, social and political dynamics of contemporary natural history practices and publishing. In Pietro Corsi's views, such absence or paucity of interest for made us blind to major debates of great significance for the history of the life sciences at European level during the early decades of the nineteenth century. Accordingly the ways in which Lamarck was read, admired, criticized or denounced might be considered a mile stone of the modern reappraisal of history of evolutionary thought.

Even for philosophy it is not true that *les jeux sont faits*. Wittgenstein famously remarked in [16], "Darwin's theory has no more relevance for philosophy than any other hypothesis in natural science." Yet today we are witnessing a major revival of interest in applying evolutionary approaches to philosophical problems, as Michael Ruse accomplished recently with the *Philosophy after Darwin* [13], an anthology of essential writings covering the most influential ideas about the philosophical implications of Darwinism, from the publication of *On the Origin of Species* to

today's cutting-edge research. Along this same red line, Ruse argues that "work being done today on evolution and philosophy as part of a broader cultural movement. In some very deep sense, it is part of a movement to see human beings in a naturalistic fashion, this being set against more traditional attempts to locate humans in a religious, a spiritual, a non-naturalistic world. One aim, as you might already have guessed, will be to show that the story is not quite as straightforward as one might have expected."

Always on philosophy side, Paolo Casini notes that when John Dewey, in his essay *The Influence of Darwinism on Philosophy* (1909), remarked "The exact bearings upon philosophy of the new logical outlook are, of course, as yet, uncertain and inchoate. We live in the twilight of intellectual transition". Nowadays four decades of controversy concerning evolution had elapsed, and Darwin's Darwinism was eventually accepted, The transition towards evolutionary logic, according to Dewey's subtle analysis, expelled from biology, and from philosophy as well, all ideal archetypes, the concepts of design and finality, and destroyed the philosophic idol of *ειδοςτΘ* (o *species*).

If we challenge the historical roots of evolutionary theory (as the) with its present day bearings, what remains of emotional ideas like, *The Nature, red in tooth and claw*? Peter Weingart notes that the metaphor "struggle for existence" takes its origins in everyday language but it was given a specific meaning in the context of evolutionary theory. Subsequently, the metaphor was transferred back into everyday use but had also a tremendous impact on the historical and social sciences. Darwin's metaphor is one of the most famous cases of this type of metaphor transfer into the sciences and back. Accordingly the usages of the metaphor appear really wide and loose, but nonetheless they had their time. A search for occurrence of such a phrase in titles and/or abstracts of documents in both the SSCI and SCI databases revealed only 21 entries for the period 1973–1999. Evidently it is justified to say that the struggle for existence as a metaphor has not survived the struggle for use and attention.

2 The Mankind Affair

Mankind evolutionary history can be tackled in several ways, employing tools from disparate disciplinary fields as cultural anthropology, linguistics, to-date molecular genetics.

In a fascinating approach, Henrika Kuklick explores the dialectics and the somewhat contradictory exchanges between Darwinian theory and the new born social anthropology:

> Anthropological fieldwork framed by a Darwinian biographical approach proved extremely important in changing the discipline, (perhaps paradoxically) leading to a thorough separation of cultural from biological anthropology. . . . Not until the 1980s would evolutionary approaches to the analysis of culture that were advertised as authentically Darwinian seem respectable to more than a distinct minority of socio-cultural anthropologists, but that is a

development that may be most significant as evidence of the rise of conceptual pluralism in anthropology.

A key-corner between biology and society is the language. Manfred Bierwisch draws an elegant and challenging reflection on such a conceptual and experimental labyrinth, where we ignore how many (or if any) are the exits. At a first glance, we are relying on some necessary analogies. Human language history can indeed be logically explained by an evolutionary theory, but its principles are essentially different from those that govern the development of biological species. Then the question is as to whether we have identified a principle of evolution that is universally applicable to the historical development of language and more broadly to sociocultural structures. Favoring the supposition of a fundamental role assigned to language as a basis and ingredient of veritably every sociocultural institution enabling the capacity for unlimited expression, bounding language symbols to agreed convention, Bierwisch notes that there are nonetheless grounds for reservation stemming from two considerations, the domain-specificity of the language faculty and the intentionality of social behavior, including the creativity of language use. The compelling close is that "The faculty of language is the prerequisite of human history, but it does not determine its course."

The theme of the evolution of the language immediately calls us to the extraordinary researches on the genetics of ancient human populations, where pioneering, monumental studies were performed by Luca Luigi Cavalli Sforza, Paolo Menozzi and Alberto Piazza. In the present book, Alberto Piazza is arguing on the role of natural selection, a major factor in Darwinian evolution which is elusive and difficult to dissect, especially when the case of human evolution is dealt with. In August 1858, Charles Robert Darwin and Alfred Russel Wallace presenting to the Linnean Society of London their independent discovery of the theory of natural selection, suddenly and altered our understanding of life on Earth. He is focusing his attention on five major advances of genetics on the analysis of human evolution, and especially on the comparisons between human and chimpanzee genomes and on the very recently published DNA draft sequence of the Neanderthal genome. The very questions for modern humans are:

- To which extent has natural selection influenced, at the scale of the entire genome, the degree of population differentiation?
- Which type of genetic variants have been preferentially targeted by selection?
- Genes and gene variants under strong selective pressures can highlight regions of the genome explaining the current population phenotypic variation?

The final challenge is methodological: how can we evaluate the relevance of the sexual selection in humans, starting from the many conjectures and working hypotheses put forward by Darwin, which are very plausible for animals, but very difficult to test for humans, especially in modern times when cultural factors on sexual selection may completely shadow biological pressures.

3 Development, a Persistent Problem of Evolutionary Theory

If the powerful genetics is sitting in the core of modern evolutionary theory, a blow of new ideas comes from its theoretical belt, as Evolutionary Developmental Biology (Evo-Devo). Thus Giuseppina Barsacchi analyzes the relationships between the processes of individual development and the phenotypic changes of the organism during evolution. Methodological advances such as gene cloning, gene expression screening and visualization of gene activity in embryonic tissues facilitated the emergence of a major theme of the current Evo-Devo research, the evolutionary developmental genetics program. Its foundational achievement was the discovery of extensive similarities in developmental regulatory genes and gene networks among distantly related species. The program concentrates on the evolution of genetic tool-kits and signaling pathways and on the regulatory logic that underlies organism development. Mapping the expression pattern of gene networks and signaling pathways and analyzing their correlation with the constructional features of body architecture, provides information on their possible role in phenotypic evolution. Major morphological transitions in evolution are presently recognized to be accommodated by a few key developmental genetic changes (part of a "developmental reprogramming") and "case studies" in snakes, ducks, bats, dolphins, insects, and finches, providing valuable insights into principles of evolutionary change, are presented. On the other hand, the molecular changes are rooted in an otherwise conserved developmental genetics tool-kit (e.g., the *Hox* genes for anterior-posterior patterning, the network for eye formation etc.) that substantiates the "deep homology" underlying diversity of forms. On this ground, the relationship of the deep homology of genes working through development with classic morphological homology is in the Evo-Devo field of exploration. How environmental agents can instruct changes in development, for example altering gene expression – in broad sense searching for a link between proximate causes of development and natural selection-, falls also in the perspectives of newly growing and exciting knowledge, where Evo-Devo integrates with Ecology. The problems are many and very interwoven, as Alessandro Minelli remarks: "a real Evo-Devo biology is now growing in extent and importance, but integration between the two disciplinary components is still basically fought on the battlefield, case by case" ([9], p.118). The case is for instance the principle of "developmental inertia", raised by Minelli himself, like the arguments about regeneration, developmental pathways, epigenetics, multiplicity of centers of local development dynamics as opposed to global control, and so on... Summing up, future work may further give reason for the Charles Darwin's appraisal of the importance of Embryology for Evolution.

4 Brain Evolution and Plasticity

Overcoming the traditional dichotomy opposing neural selectionism to constructivism is the goal of Ferdinando Rossi. In an extreme synthesis, Rossi is arguing in a syncretistic fashion, along the following lines of reasoning. The correct function

of the nervous system requires complex neural networks bearing precise connections. In principle, the high structural specificity of neural circuits could be achieved by genetically-determined processes, selected and refined during evolution. Highly conserved gene networks regulate some crucial steps of neural development, such as the regionalization of the neural tube and the initial phases of neurogenesis and synaptogenesis. A totally hardwired nervous system may meet the requirements of adaptation and natural selection at the population level, whereas it would be fully inadequate to allow individual organisms to cope with rapid changes of environmental conditions. Neural adaptation to external constraints can be partly achieved by introducing selective mechanisms in neural development. Accordingly, neurons are generated in excess and then partially eliminated to match the actual extension of innervation territories. Such mechanisms, however, are restricted to a set of potentialities, which must be predetermined in the ontogenetic program. On the other hand, constructive mechanisms, in which external stimuli directly influence structural modifications of neural circuits to produce adaptive responses, may allow individual organisms to cope with a wide variety of unprecedented situations. Thus, in the last ontogenetic period as well as in the adult, when the organism actively interacts with the external milieu, experience exerts a strong growth-promoting effect on neural circuits and connections inducing the emergence of specific functional properties. By this mechanism, which requires strict inhibitory control to prevent aberrant growth and dysfunction, the nervous system exploits external stimuli to create adaptive responses to unexpected situations.

Such syncretism represents a good way to handle the enormous wealth of data on brain development recently acquired. Nevertheless this approach raises some reflections on tricky concepts such as evolvability [7,11] and exploratory properties in complex systems, namely in neural tissues.

Evolvability is an organism's capacity to generate heritable phenotypic variation. Metazoan evolution is marked by great morphological and physiological diversification, although the core genetic, cell biological, and developmental processes are largely conserved. Metazoan diversification has entailed the evolution of various regulatory processes controlling the time, place, and conditions of use of the conserved core processes. These regulatory processes, and certain of the core processes, have special properties relevant to evolutionary change, reducing the interdependence of components and conferring robustness and flexibility on processes during embryonic development and in adult physiology.

Even more ambitiously, we can ask: how our brain evolved? In a masterly way, Gerhard Roth shows that the human brain is not unique in terms of general structure, since it exhibits the basic pattern typical of mammals and more specific of primates. In addition, humans do not have the largest brain either in absolute or in relative terms, although they possess a brain that is seven to eight times larger than expected from general mammalian brain allometry (defined as the study of the change in proportion of various parts of an organism as a consequence of growth). Through an elegant analysis of many other quantitative data, Roth concludes that the greatest differences between humans and all other mammals/consist in (1) a

strongly increased growth period of the human brain exposing it to a much higher degree to education, and (2) the presence of the Broca speech area which is a necessary prerequisite of syntactical language. While these two traits appear to be minor steps in human biological evolution, they had enormous consequences for human culture.

5 Old/New Concepts

One major methodological and pragmatic problem is an old and persistent one: what is the meaning of similarities, in genetics as in anatomy or in developmental processes? Three old/new friends may help to understand the nature of similarities and their bias.

Among new or renewed conceptual tools, one emerging clue is homoplasy [14]. Homoplasy is the independent acquisition of the same trait in unrelated lineages. Parallelism/convergence homoplasy occurs when the same trait is present in two lineages that lack a recent common ancestor. Reversal homoplasy occurs when a trait is present in an ancestor but not its immediate descendants; but appears later in a subsequent descendant. Understanding the diversification of phenotypes through time has been the focus of evolutionary biology for 150 years. If, contrary to expectations, similarity evolves in unrelated taxa, researchers are guided to uncover the genetic and developmental mechanisms responsible. Similar phenotypes may be retained from common ancestry (homology), but a phylogenetic context may instead reveal that they are independently derived, due to convergence or parallel evolution, or less likely, that they experienced reversal. Such examples of homoplasy present opportunities to discover the foundations of morphological traits. A common underlying mechanism may exist, and components may have been redeployed in a way that produces the "same" phenotype. New, robust phylogenetic hypotheses and molecular, genomic, and developmental techniques enable integrated exploration of the mechanisms by which similarity arises.

On the other hand, the trendy interest in development can effectively enrich our definitions of homology and our methods to individuate it. The study of developmental processes calls for a comparison at different developmental stages, overcoming the restriction to adults, which has been the focus in classical comparative studies [4]. Too often, comparative neurobiologists have considered brain evolution as the transformations of adult brains over time A more extensive interest in dynamic processes can help unveiling the plastic changes of the brain throughout life. To give a simple example, the developing human brain seems to be different at the functional neuroanatomy level from the adult brain, even in processing single words. Another puzzling problem is the genesis of novelty and its adaptive value. Interestingly enough, very recent molecular investigation on primates suggest that the human brain has probably experienced pronounced evolutionary changes in gene expression during its most recent history [3] and that the evolution of human cognitive abilities was accompanied by adaptive changes in brain metabolism [6].

These results are open to different theoretical hypotheses and should not over-interpreted, but they suggest that processes of fast genetic reorganization might sometimes occur.

In the light on these considerations, a main question presents itself: what are the adaptive pressures behind brain and behavior novelties in evolution? We have no answer yet, but we can agree with the original statement by Williams, in his [15] *Adaptation and Natural Selection*, frequently quoted in evolutionary psychology, but not so frequently exploited: "Evolutionary adaptation is a special and onerous concept that should not be used unnecessarily, and an effect should not be called a function unless it is clearly produced by design and not by chance. When recognized, adaptation should be attributed to no higher a level of organization than is demanded by the evidence." A new emphasis on homology in evolutionary biology (the persistence of theoretical problems notwithstanding), may offer new powerful tools for an effective comparative analysis, and may thus help distinguishing between strict biological correspondence and loose metaphoric representations of behavior, which are the mere result of an uncritical assumption of an evolutionary stance. Especially in cases of highly complex behavior, ethics being a paradigmatic example, biology and culture are certainly tightly entrenched: the claim that these kinds of behavior have evolutionary bases is simply a truism. The interesting point would be the possibility to identify the characters, if any, which show continuity and can be challenged by a homological analysis. The evolution of the brain involved a complex set of relationships among individual structures, both at the quantitative and the qualitative level. As aforementioned, there is some controversy concerning this idea, but the core problem (e.g., whether changes are directly selected or not) remains unsolved. It seems plausible, however, that some processes are related to environmental pressures, while others emerge in response to the need for more flexible answers, and still others are part of a less specific and foreseeable ecological niche. Likewise, brain structures have developed along several lines, and one usually finds a "mosaic-like" pattern even within a particular line.

In such a mosaic of integrated parts, whatever the evolutional process might have been, at least a part of the variation has not been selected per se, but it represents a collection of exaptations [5]. For instance, the molecular evolution of *ASPM* gene in hominoids may indeed be an example of a molecular exaptation, in that the originally selected function of *ASPM* was for something other than large brain size, since the *ASPM* gene sequence shows accelerated evolution in the African hominoid clade, and this precedes hominid brain expansion by several million years [8]. The idea that novelty may arise from and exaptation ("functional cooptation" in Darwin, then "pre-adaptation" in Ernst Mayr) can have strong impact on our views. Three typologies of processes, i.e. classical Darwinian adaptations by natural selection; the functional shift, by natural selection, from a previous function to a secondary one; spandrels and other side effects with no adaptive reasons in their beginning, possibly co-opted by natural selection in new external conditions can extend the taxonomy of fitness [5,10].

6 Cognition and Reasoning

Moving from comparative neuroanatomy to modern cognitive neuroscience, Giorgio Vallortigara explores recent research updating Darwin's implicit suggestion that there maybe primitive neural pathways that ensure a bias toward sensory cues about other living things, in particular members of the same species. There has been of course a long road from the primitive animacy detectors that we can see operating even in simple brains to the intricacies of agency attribution and theory of mind of human beings. Nonetheless, the origins of beliefs in supernatural things and of our intuitive dualism seem to be deeply rooted in natural history.

"Thus reason does not have to keep repeating why it holds itself to be so important if it can see how it became necessary and under what conditions it is in fact indispensable." Volker Gerhardt believes that evolutionary theory can liberate reason from the burden of its thousands of years of self-confirmation and lead it back to the conditions that preceded it that are themselves not yet rational. It might not exist any other problem that the natural sciences and the humanities should take a greater interest in. For it is in the natural elucidation of the origin and the potential achievements of reason and consciousness that both fields have the chance to shed light on themselves as well and to clarify why they not only emerged from the same impulses of curiosity, knowledge, and rational guidance, but continue to depend on one another.

Finally, Pievani reflects on the current status of theory of evolution: how it changes and grows, remakes itself keeping alive and reinforcing its Darwinian explanatory core. The starting point is the awareness that the capacity of assimilation of scientific novelties by Modern Synthesis (MS) seems to be progressively declining. The problem is seemingly no longer its "incompleteness", but the adequacy of the whole conceptual structure of the theory [5]. Using Imre Lakatos' methodology, Pievani argues that the transition in progress from the MS to the so called "Evolutionary Extended Synthesis" (ES) [12] could be represented as a shift from a previous evolutionary research, and a new evolutionary research program, with an extended Neo-Darwinian core and a protective belt of new assumptions and auxiliary hypotheses with a pluralistic and integrative explanatory approach. Promising and advanced researches – like those concerning evolutionary developmental biology (Evo-Devo), epigenetics, multiple ways of speciation and the role of structural internal constraints – find in this perspective a realistic interpretation as theoretical and empirical novelties with huge implications, nevertheless not incoherent with an extended Neo-Darwinian explanatory core. Such approach seems also useful discussing the extension of evolutionary models in non biological fields, in order to avoid just metaphorical forms of "ultra-Darwinism".

Summing up, the debate on evolution is still open and strives us to exchange and change ideas. What may be our philosophical and scientific endeavour, we can agree with Michael Ruse, expecting "that in fifty years or a hundred years we will still have the theory of the *Origin* around. Great, precisely because it does not

stand still, but remakes itself and grows and changes by virtue of the fact that it gives such a terrific foundation. Is Darwinism past its sell-by date? Not by a long chalk yet!"

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Idola Tribus: Lamarck, Politics and Religion in the Early Nineteenth Century

Pietro Corsi

Abstract There is no doubt that traditionally the history of evolutionary ideas has been and is Darwin-centred. I have no dispute with this, being a convinced "Darwinian", in spite of years of work I have devoted to study Lamarck and the many non-Darwinian theories of evolution current in Europe and the United States before and after 1859. Whereas historians have paid some attention to post-Darwinian, non Darwinian theories, pre-Darwinian theories have been much neglected. Attention is usually paid to so-called "Lamarckian" attitudes present in European natural history debates from the early 1800s to the 1850s, only to conclude that Lamarck played no role, was almost unanimously neglected and in any case unanimously vituperated. This was hardly the case. However, the aim of my paper is not to vindicate Lamarck, but to argue that even concentration on Lamarck would amount to gross anachronism. After analysing reasons – essentially political and religious – that have been given to explain the alleged oblivion into which Lamarck's works had fallen (if they ever rose to attention) I will examine evidence concerning the wider debate on Lamarck's ideas within the medical literature of the 1810s and the 1820s. This will open up a new research area, focussed on the translation into French of major German authors (Meckel, Tiedemann, Carus, Treviranus, Burdach, Oken) and on the attempts to re-formulate key Lamarckian tenets in the terms of German natural philosophy, comparative anatomy and embryology, and medicine. The debate on the development of life – historical and embryological – was wider and much more interesting than the debate on Lamarck's own theories, which in any case well deserves to be rescued from oblivion.

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All differences taken into account, Lamarck and Darwin shared the common destiny of being often identified with doctrines they never upheld, or not exactly in the form history has attributed to them. Over the last century and one half, wave after wave of the recurrent debate on "Lamarckism" vs. "Darwinism", and the repeated rituals of centenary and other anniversary celebrations have done much to obscure the real contribution of the two naturalists to the debates on evolution. In saying so, I am of course taking for granted several assumptions, some of which will be spelled out and discussed in the following pages. A major assumption which will not be critically scrutinized, and is presented here as a comment at the end of one year of world-wide celebrations, is that in-depth and easily available historical studies on Lamarck and Darwin have been rarely read or consulted by a good number of commentators who during 2009 have been very active explaining who Darwin really was. Nor have they been consulted by the much lower number of those who remembered that 2009 marked not only the bicentenary of the birth of Charles Darwin, but also of the publication of the *Philosophie zoologique*, one of Lamarck's key evolutionary texts. The impression one gets, after reading, viewing, or listening to a statistically relevant portion of what has been said on Darwin during 2009 through several continents and languages, is that his works, as those of Lamarck, are not that well known, and that the work of professional historians who have engaged the primary sources is scarcely taken into account. This is not a novelty, after all: since the early 1800s much of the debate on what we call today "evolutionary" doctrines was carried on without much attention to the actual articulations of the "scientific" arguments under discussion.

Before stating and developing the key themes of my paper, let me provide only one example of what I peremptorily stated above. There is no doubt that the doctrine of the inheritance of acquired characteristics is universally regarded as the cornerstone of Lamarck's theory and the major point of difference with Darwin and Darwinism. Yet, as Jean-Gayon has persuasively argued, and a rapid search by word of the Lamarckian corpus available on line will confirm, Lamarck never spoke of the theory of the inheritance of acquired characteristics.[1] He most surely believed that new needs originate new behaviours, and new behaviours increase or decrease the size and functions of the solicited organs, to the point that new species and genera are formed. Life is thus constantly transformed, since the process is cumulative through inheritance. This was a conviction he shared with many authors active at the end of the eighteenth and at the beginning of the nineteenth Centuries, to the point that early critics of Lamarck rarely complimented or reproached him for this. The key issue when discussing Lamarck was always whether the process of change he had described was sufficient to overcome the species or the genus barrier – a point some were ready to concede – as well as higher divides (family, order) – which very few granted. Fifty years later, the same reaction characterized the early

[1] Jean Gayon, "Lamarck Philosophe", in P. Corsi et al., *Lamarck philosophe de la nature*, Paris, PUF, 2006, pp. 9–35. See P. Corsi, http://www.lamarck.cnrs.fr/ for the complete edition of Lamarck's theoretical works, his manuscripts and herbarium.

(and later) debates on natural selection: many saw it as a plausible mechanism to explain the fixation of varieties, which could in no way put in doubt the constancy of species, or of genera.

The interesting question that emerges from carefully comparing the relevant Lamarckian and Darwinian texts, is that the capability of organisms to change and to pass on to the next generation whatever was gained or lost during their lifetime was severely limited in the case of Lamarck, and less so with Darwin. For Lamarck, only very young organisms, in which the tissues were still very soft, and the circulation of blood, nymph, and the nervous and other fluids was particularly brisk, showed a potential for adaptive change: never the adults. This was not Darwin's opinion. When presenting the ill-fated and little studied theory of pangenesis, among other phenomena of heredity Darwin sought to explain how a change that occurred at a given point in the life of one organism tended to appear again at the same stage of individual development in his progeny. Furthermore, whereas Lamarck simply took up a widely shared, almost commonsensical belief that the characteristics of the parents were passed on to the next generation, Darwin spent time and ink to understand how this was possible, even discussing similar theories put forward by authors such as Georges-Louis Leclerc, Comte de Buffon (1707–1788) and Charles Bonnet (1720–1793), on whom Huxley had called his attention.[2] Lamarck spent much less time on the matter: he simply argued that since the male seminal fluid (akin to electricity and magnetism) acquired specific peculiarities within each type of organism, it was legitimate to infer that the same fluid would take up slightly different anatomical and functional properties by circulating through an organism that had undergone a very slight change during the early phases of its life. Indeed, for Lamarck, fully blown characteristics were the end result of a cumulative process of very minor changes within the fluid dynamics internal to all and every organism. Thus, if a new need was requiring a more pronounced use of a given organ, thereby increasing the flow of blood, nutritional and nervous fluids to that part, what was passed on to the next generation (provided the young individuals that had gone through the same process reproduced together when adults), was not a character that as yet did not exist, but the slight change in the pattern of the fluid dynamics and the slightly modified features of the seminal fluid. On the contrary, Darwin admitted the inheritability of changes occurring in a single parent, and asked himself how these could be maintained through successive generations. This is not to conclude that Darwin was more Lamarckian than Lamarck, but to insist on the fact that the mere reading of the works of Darwin and Lamarck would prevent all hasty and easy generalizations.

Even though rarely read by those who should, the scholarship on Darwin of the last 40 years has been on the whole excellent and has powerfully contributed to a

[2] See C. Darwin, *The Variation of Animals and Plants under Domestication*, 2 vols., London, J. Murray, 1868, vol. 2, Ch. XXVII, "Provisional hypothesis of pangenesis", pp. 357–404.

less anachronistic appreciation of the man, his career and doctrines.[3] The case of Lamarck, on which I will devote the main bulk of my paper, is to some extent quite different. There are of course excellent studies of his work and career, though the writings of the French naturalist have not been translated or edited with the same alacrity and systematic dedication.[4] There is no correspondence left worth mentioning, no notebooks, no autobiographies or diaries. Much of the Lamarckian manuscripts are in fact drafts or final versions of printed works. Lamarck was very parsimonious with information about himself, his life and thoughts, to the point that much of the scarce biographical hints we have are due to members of his family, his enemy Cuvier or to a young medical practitioner who interviewed him in the early 1820s.[5] Moreover, whereas over the last 20 years or so important scholarship has appeared offering insights into the wider natural history scene (institutional, intellectual and social) of the United Kingdom, the same cannot be said of France during the times in which Lamarck was active. In other words, the scholarship on Lamarck has not incited new studies on the wider scientific and institutional context characterizing the life sciences during the early decades of the nineteenth century in France.[6]

The rare albeit excellent exceptions to the rule have not helped us to gain a less anachronistic view of contemporary priorities, actors and debates. The set of traditional assumptions concerning the context of Lamarck's work remain stubbornly unchanged, in spite of growing evidence that should advice historians to enlarge the scope of their research. It is a few of these implicit, often untold assumptions I wish to tackle in the following pages. Basically, they turn around a major conviction, the total or almost total isolation Lamarck lived in. This assumption generates in its turn a host of further assumptions – if not prejudices – asked to perform a causal role in the narrative. They can be ranged, historically and thematically, from the (usually French) patriotic and whiggish explanation that Lamarck was born too early, or that he was seeing too far, to the less charitable (usually Anglo-American, pro-Darwinian) view that he was simply wrong, overwhelmed by top brass of science such as Georges Cuvier (1769–1832), Pierre-Simon Laplace (1749–1827), or Antoine Lavoisier (1743–1794) and his pupils.

[3] I will only refer here to the biographies by A. Desmond and J. Moore, *Darwin*, London, Michael Joseph, 1991 and *Darwin*, Oxford, Oxford University Press, 2007; and J. Browne, *Charles Darwin*, 2 vols., London, Jonathan Cape, 1995–2002.

[4] See for instance R. Burkhardt, *The spirit of system: Lamarck and evolutionary biology*, Cambridge, MA, Harvard University Press, 1977, 1995.

[5] Georges Cuvier,. "Éloge de M. de Lamarck, lu à l'Académie royale des sciences le 26 Novembre 1832", in *Mémoires de l'Académie royale des sciences de l'Institut de France*, 13 (1831–1833), pp. i–xxx; Isidore Bourdon, "Lamarck", *Dictionnaire de la conversation et de la lecture*, 34 (1837), pp. 265–269.

[6] See for instance J. Secord, *Victorian sensation: the extraordinary publication, reception, and secret authorship of Vestiges of the Natural History of Creation*, Chicago and London, University of Chicago Press, 2000, and J. Endersby, *Imperial nature: Joseph Hooker and the practices of Victorian science*, Chicago and London, University of Chicago Press, 2008.

He had no chance to be listened to in a world moving towards disciplinary specialization and epistemological rigour. A second assumption concerns the inevitability of Lamarck's isolation in the increasingly conservative political climate of the Consulate and the Empire, and in the ultra-conservative intellectual atmosphere of the restored monarchy. His materialistic biology and transformist doctrines (it is claimed) were unacceptable to authorities determined to curb any form of political and intellectual subversion. Finally, the third assumption we are going to examine below is the one concerning the audience of Lamarck's works. Followers of various versions of assumptions one and two will find this third point completely superfluous. To them, Lamarck had no audience worth talking about, at least until the 1820s, and even then the few who paid any attention to him did not, in fact, support his views as the old naturalist would have wished. In France as well as in Europe, Lamarck's materialism found sympathetic hearing only within the radical fringes, thereby adding to the already long list of reasons people had to dismiss him outright.[7]

The way in which the assumptions we have sketched above have been argued by historians does not lack plausibility and evidential support. Yet, consensus has been gained at the price of restricting the research horizon to the point of neglecting major features of natural history practices and debates of the early nineteenth century, in France as well as elsewhere in Europe.

1 Lamarck Versus Institutional Science

Very few historians of early nineteenth century life sciences appear to doubt that the major educational and institutional reforms introduced by successive revolutionary governments, the Directory, the Consulate and the Empire deeply changed the social and intellectual practices of research within the complex articulation of disciplines still constituting the "histoire naturelle". To a significant extent, they are absolutely right. In 1792, 1793 and 1799, two naturalists occupying the opposite sides of the epistemological spectrum in the debate over natural history agreed that France was not doing much, after all. Jean-Claude de la Métherie (since 1793 simply "Delamétherie") and the then still little known Cuvier insisted that Germany was better equipped than France in several sub-domains of natural history. Cuvier pointed out that almost every German university town was publishing its own scientific or medical journal and hosted important private and public collections. In France, almost everything was concentrated in Paris, and Parisian naturalists were too happy to sit on the top of their monopolistic privileges to care about sharing their knowledge with colleagues in the provinces and abroad. As a

[7] The best known and best argued representative of the view that Lamarck was acceptable only to extreme radicals is Adrian Desmond, *The Politics of Evolution. Morphology, Medicine and Reform in Radical London*, Chicago and London, University of Chicago Press, 1989.

consequence, France was rather poor in periodical publications, since only a handful had survived the revolutionary years, and there were not that many even before 1789, for that matter.[8]

In the space of a few years the situation changed dramatically and unpredictably. The Revolutionary armies engaged in the systematic plundering (which they called "confiscation") of conquered lands, to finance the huge state deficit and the costs of the war. Cash, precious minerals, paintings and sculptures, natural history and scientific instrument collections took the road to Paris in hundreds of over-charged wagons. The *Muséum national d'histoire naturelle*, established in June 1793, was the ideal place were natural history collections could be hosted, catalogued and studied on behalf of the Republic of knowledge, which did not know of frontiers or wars. Confiscations were undertaken with a higher view in mind, the benefit of mankind, French authorities insisted.[9] By 1802, Paris hosted the largest and richest natural history collections ever assembled in Europe. Naturalists from all over the Continent had to pay frequent visits to the French capital: some, undoubtedly, to pay due homage to the new rulers; others, because they had to keep up with their own work. The local German collections Cuvier had extolled in 1799 were no more sufficient to guarantee cutting edge research.

French scientific publishing also benefited from the new impulse successive governments accorded to the practice of science.[10] The at times purely symbolic

[8] Georges Cuvier, "Extrait d'une Notice biographique sur Bruguière, lue à la société philomathique, dans sa séance générale du 30 nivôse an VII", in *Magasin encyclopédique*, 5th year, vol. 3 (1799), pp. 42–57; Louis Marchant, *Lettres inédites de Georges Cuvier a C. H. Pfaff sur l'histoire naturelle, la politique et la littérature*, Paris, Victor Masson, 1858, p. 78: "Les sciences ont aujourd'hui peu de dignes prêtres en France, et cette pauvreté est d'autant plus pénible, que l'on se souvient encore de l'ancien éclat dont elles ont brillé"; Jean-Claude Delamétherie, "Discours préliminaire", in *Journal de physique*, 42 (1793), p. 7. See also A.-L. Millin, "Journal d'histoire naturelle", in *Magazin encyclopédique*, 1, n. 8 (8 décembre 1792), pp. 57–60, "L'Allemagne voit paroître un grand nombre de collections, et de recueils d'histoire naturelle", p. 57.

[9] For two recent systematic studies of the accumulation of collections in Paris see B. Daugeron, *Apparition-Disparition des Nouveaux mondes en Histoire naturelle, Enregistrement-Epuisement des collections scientifiques (1763–1830)*, Paris, EHESS, Thèse de doctorat, 2007, 2 vols.and P.-Y. Lacour, *La République naturaliste. Les collections françaises d'histoire naturelle sous la Révolution, 1789–1804*, Florence, European University Institute, Ph. D. Dissertation, 2010, 2 vols. It is interesting to point out that in his biographical notice of Bruguière (see n. 8) Cuvier complained that the collections amassed at great public expense were now collecting dust at the Muséum, since no one appeared to work on them. This too was soon to change, but systematic exploitation of the conquered natural history riches only started after 1802, that is, after Cuvier became full professor there. The political innuendos of Cuvier's astonishing biography of Bruguière, his equally astonishing veiled attacks against colleagues working at major State institutions have never been analyzed in detail.

[10] Amongst many, the testimony of Louis Marchant, *Lettres inédites de Georges Cuvier*, is telling, p. 30: "C'était une époque très-favorable pour les sciences et ceux qui les cultivaient; le premier consul se trouvait très-honoré du titre de membre de l'Institut, il le mettait en tête de tous les autres. Les premiers hommes de la science, comme Laplace, Chaptal, Monge, étaient en même temps les