LAMARCK:
TAXONOMY AND THEORETICAL BIOLOGY

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RESUMEN

No trataremos de la teoría evolutiva de Lamarck, ni de otros aspectos de su trabajo que inmediatamente aparecen en nuestro pensamiento cuando reflexionamos sobre la herencia que nos legó. En su lugar discutiremos temas menos conocidos de su ideario, como su teoría de las clasificaciones y su aproximación holística a la biosfera, que en mi opinión no han sido suficientemente valorados.

SUMMARY

I will not deal with Lamarck's theory of evolution, nor with other aspects of his work that usually first spring to mind when one thinks of the heritage that he left us. Instead I will discuss less well-known aspects of his thinking, namely the theory of classifications and the holistic approach to the biosphere, which in my opinion have not been sufficiently appreciated.

1. THE CLASSIFICATIONS.

To talk of Lamarck as a classifier and of the importance of his taxonomy was considered a provocation even in recent times. This is because the thesis that Lamarck was a Buffonian (which is only partly true) and that Buffon was an "enemy of systems", had become consolidated in time (Guyénot 1941, p. 76; Montalenti 1965, p. 248; Hanks 1966, pp. 9-10). The latter affirmation is unfounded, since the author of *Histoire naturelle générale et particulière* (1749-1789) did not deny the validity of classifications in general but only the Linnaean one (Barsanti 1983, 1992). Another myth that we must discredit is that progressive contributions to the refinement of classifications could come only from exponents of the Linnaean "school". In reality, for certain parts of nature, they came only from the Buffonian school, Lamarck in particular.

Although running the risk of beginning with a banality (but evidently there is still the need to state the obvious), I would mention that Lamarck was not only the author of the famous *Philosophie zoologique*, the text of 1809 improperly considered the first "manifesto" of evolution[1]. He also compiled the monumental *Histoire naturelle des animaux sans vertèbres* (1815-1822), which I consider his masterpiece. This consists of seven thick volumes of systematics, and of a systematics so well conceived that it remained the principal point of reference for many decades. To give just one example, on Darwin's long voyage throughout the world (1831-1836), he used exactly those volumes to identify species —and it has been documented recently that his systematics of the invertebrates is Lamarckian (Sloan 1985).

The *Histoire naturelle* was preceded by the *Système des animaux sans vertèbres* (1801), and this by a very ambitious project that until now has passed unobserved,[2] but which I found among the documents housed in the *Archives Nationales* of Paris (AJ15.548). Lamarck presented it to the Committee of Public Instruction on the 4 *vendémiaire* of year III of the Republic (25 September 1794). Lamarck proposed the compilation of a massive *Système de la nature* in eight volumes. In addition, the French naturalist caught the attention of the scientific community with *Flore française* (1778), which was studied by generations of botanists. If then we must certainly admit that many threads connect the writings of Lamarck, we perhaps have to concede that the *fil rouge*, the most substantial one, is the systematic approach —that *spirit of system* on which Richard Burkhardt in particular has insisted (1977, 1995).

The Lamarckian project of 1794, despite its brevity, is particularly persuasive testimony to the nature of this approach (see Barsanti 1996 for a more detailed treatment). For reasons of space, I must omit discussion of the fact that, in this work, Lamarck counted much on the wounded pride of the French nation (see p. [2]; Barsanti 1996, p. 226); after having exercised a long domination over European culture, France had been constrained for some time to import foreign models —mainly on account of Linnaeus. I am also not able to expand on the fact (which though is significant) that, at an early stage, Lamarck had thought to coordinate a team of specialists, and later, in order to save the «*unity of the plan*» of the work, he declared himself willing to compile it alone (see p. [3]; Barsanti 1996, p. 227). I also cannot comment on the fact that his *Système de la nature* would have been unbalanced: of the eight volumes, only one would have covered the entire mineral kingdom, not more than two would have been dedicated to plants (compared with the five devoted to

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[1] It was preceded by *Recherches sur l'organisation des corps vivans* (1802), of which *Philosophie zoologique* constitutes a sort of second edition, and by *Discours d'ouverture du cours de zoologie donné* [...] *l'an VIII de la République* (1800). Hence the decision by Pietro Omodeo to include only the last work in the Italian edition of Lamarck's *Opere* (1969) was a fortunate one.

[2] LANDRIEU, M. (1909) reproduced it, but provided only a few lines of secondary comments (pp. 95-97).

to animals), and three would have concerned the invertebrates. And finally I omit to speculate about the reasons for which the project failed to be realized.

More interesting is the analysis of how much we can ascertain, from the four pages of the outline, about the organization of the project. It appears to be innovative, with respect to the work of Linnaeus, in at least five characteristics. First, in its content, to which its size provides indirect testimony: eight volumes in octavo are double what was sufficient for the twelfth edition of *Systema naturae* (Linnaeus 1758-1759). Lamarck thought to fill the volumes not only with the *definitio* of species (as per Linnaeus) but also with their *descriptio* (as Buffon wished), in other words with what the French naturalists called the *historique*: not merely the morphological-anatomical description but also the physiological, environmental and, if relevant, the behavioral one.

The project was innovative, in the second place, for the choice of taxonomic criteria. Lamarck would have classified the species not only according to the morphological-anatomical traits, and even less by a selection of them, but by taking the algebraic sum of the resemblances and the differences identified after consideration of all the information collected (including the ecological-ethological data) and attributing to them the same importance. I do not believe that I am being anachronistic if I state that, within the Buffonian "school", the phenetic program of research was already being planned, and that Lamarck's project was a first outline of numerical taxonomy[3].

Thirdly, the project appears innovative for the condemnation of the Linnaean choice to favor «*imperceptible generic traits*» for taxonomic purposes (see p. [2]; Barsanti 1996, p. 226) —e.g. in plants, stamens and pistils. This was a criticism already expressed by Buffon: he argued sarcastically that «*since the traits are taken* [in *Systema naturae*] *from infinitely small parts, one must go into the woods with a microscope in order to identify a tree or a plant; the size, the form, the structure, the leaves, all the visible parts have no use anymore. Only the stamens exist: and if one cannot see the stamens, one does not know anything, one has not seen anything*» (Buffon 1749-1789, I, 1749, p. 19).

We should also remember the equally harsh criticism of the artificiality of the Linnaean classification (which, being based on a few traits rather than on an objective picture, is an arrangement «*as arbitrary as alphabetical order*»*;* Buffon 1749-1789, I, 1749, p. 24) and finally, and above all, the condemnation without appeal of «*genera too rich in species*» (see p. [2]; Barsanti 1996, p. 226): that is of *taxa* that are too broad, and thus intolerably heterogeneous. Buffon had already indicated such criticism (what sense is there «*to put together, in the same classes, the mulberry and sting-*

[3] This might be surprising, since one might think that the first evolutionist should, as such, have tended rather toward proto-cladistic solutions. However, we should remember that at the time there was no idea of the differences between the relations of analogy and homology (a distinction made only by Owen in 1843) and that to propound his theory of evolution, based on animal behavior, a numerical taxonomy that reserved adequate space for behavioral data was more than sufficient for Lamarck.

ing nettle, the tulip and wood sorrel, the elm and the carrot, the rose and the strawberry, the oak and the pimpernel»?; Buffon 1749-1789, I, 1749, p. 18) but it was Lamarck who put it into practice. And on this topic it is worth dwelling a bit longer.

At the end of the 1700's, all invertebrates were still classified, according to Linnaeus and his followers, into only two classes: Worms and Insects. Indeed Lamarck inherited an even worse situation, since the invertebrates did not even exist as such: they appeared in the worn-out Aristotelian vestment as «*white-blooded animals*». It was the French naturalist who transformed them, finally changing criterion, into «*animals without backbones*» (1795) and who first declared himself unsatisfied with their division into only two classes. This has not yet been adequately emphasized. Hence we should remember that in the ultimate Linnaeus, the twelfth edition of *Systema naturae*, the medusa is a Worm (Linnaeus 1758-1759), and that for the great Cuvier, whose work was so celebrated and whose *Tableau élémentaire de l'histoire naturelle des animaux* was a reference book, the crab was an Insect (Cuvier 1797).

Lamarck inherited this systematics, and on this he intervened so heavily, in order to institute homogeneous *taxa*, that he revolutionized it. Already in 1801 (*Système des animaux sans vertèbres*), he brought to seven the number of invertebrate classes —Polyps, Radiates, Worms, Insects, Arachnids, Crustaceans, Molluscs— while in 1809 (*Philosophie zoologique*), he increased it to ten by creating the Infusors, Annelids and Cirripeds, and in 1815 (*Histoire naturelle des animaux sans vertèbres*) to twelve by introducing the Tunicates and Conchifers,[4] for a total of 38 orders.

Certainly there was still much more to do, but here I was interested in showing that we are in debt to Lamarck at least for having broken the spell that paralyzed systematics, for making a contribution much greater than those usually attributed to him. Indeed, paradoxically, some scientific advancements are attributed to him —and at times magnified— without foundation. This is the case, for example, of Lamarck's presumed great contribution to the systematics of the primates. It is worth looking at this episode more closely because it is interesting also from the epistemological point of view.

It has been stated, and is still repeated, that the greatness of Lamarck consists in the fact that he was the first not only to hypothesize the descent of man from the apes but also to identify the chimpanzee as the species closest to us, from which we could have derived. However, although the second part of this affirmation is correct (see Lamarck 1802, p. 135 and 1809, I, pp. 349-352), it is equally true that this identification was not to the merit of Lamarck but occurred by accident, if not by error. It was the result of an operation conducted with much carelessness —if not with the intention of malice.

The history of primatology (see Barsanti 1990) is so complex in the crucial period 1750-1850 that to provide certain information while ignoring others could lead to its distortion. However, with regard to the twenty years spanning the 1700's and 1800s,

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[4] Thus the succession of the classes established was: Infusors, Polyps, Radiates, Tunicates, Worms, Insects, Arachnids, Crustaceans, Annellids, Cirripeds, Conchifers, Molluscs.

those in which Lamarck conceived and refined his evolutionary theory, it can be summarized as follows. The gorilla, which had been discovered in the early 1600's (Battell 1613), had never reappeared and taxonomically did not exist. The chimpanzee instead had been known for years and by then had also been relatively well described and illustrated (see Tyson 1699). However, it was the bonobo —a «*pygmy*», as it was aptly called, too small to be considered our ancestor. Thus Buffon and his students preferred (and they could not have done differently) the orangutan; although the reports of it by travellers were not controllable, the orangutan constituted the only "man-sized" ape available.

The first skeleton of an adult orangutan was examined (1795) in the exact institution in which Lamarck worked —the Muséum d'Histoire Naturelle. Yet since he dealt with invertebrates, it was classified by Cuvier and Geoffroy Saint-Hilaire, who included it among the Baboons (Cuvier and Geoffroy Saint-Hilaire 1795, 1798). This is because the two young naturalists initially classified the primates only according to their degree of prognathism —that is the magnitude of the «*facial angle*», as had been conceived by Camper (1791). This penalized the orangutan (which, they agreed, was even able to assume the erect posture) and it ended up at the second to last place on the «chain» of the apes, a long way from the human species.

I examined that skeleton and measured its facial angle according to the methods of the time and was able to ascertain (Barsanti 1989) that Cuvier and Geoffroy Saint-Hilaire behaved very incorrectly: they did not even perform triangulation and defined the value at their desk in order to ensure that the first 'man-sized' ape did not threaten traditional metaphysics. Theirs was an operation that was ideological rather than empirically based. Yet that value was accepted and the orangutan remained a baboon for thirty years (until Owen 1835). Lamarck was thus forced to fall back on the chimpanzee. His was not a happy choice, indeed not even a choice: it was an obligatory step, imposed by the circumstances.

2. THE HOLISTIC APPROACH.

Here I will concentrate on Lamarck's battle for the emancipation of biology from the physical sciences. This battle can be assumed, in a way, as the appendix to an enterprise that was collective and ongoing for some time (see Barsanti 1994). However, one must agree that Lamarck's contribution was decisive —as is testified to by, among other things, the fact that it was Lamarck who coined the neologism «*biology*»[5].

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[5] See LAMARCK, J.B. 1800a (about which Grassé 1940-1945 and Klein 1954). The term had already been used by Roose (1797), but as a synonym of physiology. Lamarck introduced it to connote instead the «theory of living bodies» (1801-1802, p. 8), which investigates «what is their origin and what are the

Biology began to take shape, as a science without an autonomous statute, because starting from 1740 phenomena were discovered that clearly did not conform to the laws of mechanics (or even violated them). They thus placed in serious difficulty the traditional paradigm, based on the «*sovereignty of physics*» (Venel 1753, p. 340). The parthenogenesis of aphids (see Bonnet 1745), the regeneration of amputated parts in the «*fresh-water polyp*» (*Hydra viridis*; see Trembley 1744), the characteristics of muscle contractility (see Haller 1752), the capacity for «*resurrection*» of rotifers, tardigrades, etc. (see Needham 1745, Spallanzani 1765, 1776a, Adanson 1767-1770, Fontana 1775) constituted —as was aptly stated— «*a novel spectacle*» (Trembley 1744, I, p. 14) and revealed the existence of «*another world*» (Bonnet 1764, I, p. 223). In fact, these phenomena were incomprehensible in the light of mechanics; not only had they not been predicted, they should not have existed. Hence great astonishment spread on account of the discovery —in the words of Delamétherie— that the living being was «*a machine that confounds all our ideas of mechanics*» (Delamétherie 1787, II, p. 292). Soon the amazement turned to rejection and the first anti-mechanist 'manifestoes' appeared (in Buffon 1749, Maupertuis 1751, 1752, Haller 1757-1766, Bonnet 1762, 1764, Ménuret de Chambeau 1763, 1765, Barthez 1778, Blumenbach 1779-1780, Bordeu 1782). With time, they not only increased but were ever more peremptory in their positions (particularly in Darwin 1794-1796, Bichat 1800, Cabanis 1802) in favor of a separation of the life sciences from the physical sciences.

In this process of discovery (both empirical and theoretical) of biological complexity, the intervention of Lamarck was crucial. In discussing the irreversible sclerosis of the «mechanist philosophy», the French naturalist was not limited to repeating (as did Bichat in those years) that «*the science of living bodies must be dealt with in a completely different way from that in which the sciences of inorganic bodies are treated*» (Bichat 1800, p. 83). This had been repeated for decades, but to continue to do so without being able to indicate that «*different way*» was clearly becoming counterproductive, since it indicated the impotence to identify a solution to the problem. Hence positions like that of Cuvier could be justified and diffused: he still asked for time for the «mechanist philosophy», stating that «*one would be wrong to think to be able to base oneself on the unsuccess of the efforts the physicists have made so far, in the attempt to link the phenomena of living bodies with the general laws of nature, to conclude that those phenomena are in fact of a different kind*» (Cuvier 1800-1805, I, 1800, pp. 8-9).

Lamarck's contribution was crucial because it finally permitted a way out of the *impasse*. It allowed this because the French naturalist finally provided biology with its

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principal causes of their diversity, as well as the development of their organization and their faculties» (1800a, p. 269).

first working hypothesis, and it is only when provided with a rigorous program of research that a field of study can be proposed as a discipline in itself, the only authorized interpreter of its domain of phenomena. That working hypothesis was the theory of evolution. Yet I will not dwell on Lamarckian *transformisme*, both for reasons of space and because it is well known. Instead, it is worth concentrating on one of its particular aspects (the dialectic of the relations between the organism and the environment) and on the Lamarckian concepts of «*life*» and «*organization*», with which I will conclude.

Lamarck theorized a circle of interactions between the organism and the environment: an environmental change causes a behavioral one, which produces a functional change, which causes an anatomical one, which in turn produces another functional change causing a behavioral one, producing an alteration of the environment, and so on.[6] This indicates that he considered not only environmental influences —a commonplace in the second half of the 1700's— but also (and in this he was among the first) the impact that the evolution of animal behavior —of the «*manières de vivre*», the life forms (Lamarck 1800b, p. 466)— had on the environment.

Not by accident, the French naturalist wrote one of the first environmentalist pages in the history of Western civilization, where the denunciation of indiscriminate exploitation of natural resources is accompanied by a precise condemnation of the dominant cultural models: «*because of his selfishness and imprudence, because of his tendency to seize all that is available to him, in other words because of his carelessness about the future and his fellows, man seems to work toward the annihilation of his means of preservation and the destruction of his own species. The destruction everywhere of the large plants that protect the soil, in order to dig up objects that satisfy his momentary greed, leads to the drying up of the water sources, drives away animals that relied on them for their sustenance and ensures that large regions of the globe, once fertile and populated, are now nude, sterile, uninhabitable and deserted. Forgetting the lessons of experience to indulge in his passions, man is perpetually at war with his fellows and he destroys them everywhere and with any pretext; in this way we see populations, once numerous, wane ever more. One would say that, after having rendered the globe habitable, man has marched toward self-destruction*» (Lamarck 1820, pp. 154n-155n).

Less well known, and still not adequately appreciated, is the fact that Lamarck was one of the first to use the modern concept of environment (passing from the rather poor dimension of *climat* to that of *milieu*; see Barsanti 1979, pp. 101-134) and theorized that the environment does not act directly on organs, apparatuses and systems but on a dimension that —itself— leads to the modification of organs, appara-

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[6] This in regard to the «intelligent» animals (all the vertebrates) and the «sensitive» ones (Molluscs, Cirripeds, Annellids, Crustaceans, Arachnids, Insects); regarding the «apathetic» ones (Worms, Radiates, Polyps, Infusors) and all the plants, he theorized the direct influence of external factors (see LAMARCK, J.B. 1809, I).

tuses and systems. The direct interlocutor, so to say, of the external environment is the internal environment of the organism, which confers an albeit obscure «*knowledge of self-existence*». This activates a «*tendency to preservation*» which is manifested in a series of active responses, among which the perception of new needs, the adequate modification of instincts (conceived as inherited «*habits*») and the refinement of survival strategies (Lamarck 1815-1822, III, 1816, pp. 237-240). Lamarck resolutely denied that the organic modifications not acquired in this manner had anything to do with the evolution of species. And from the theoretical point of view, perhaps the most interesting aspect of this theory is that, for Lamarck, the animal is not only "immersed" in the external environment but also in its own internal environment, which constitutes not only the "filter" through which pass the environmental pressures but —I would go as far as saying— the central "place" of evolution.

Finally it is worth discussing the Lamarckian concept of «*life*» and the related concept of «*organization*». For Lamarck, *"to live"* meant simply to perform functions, which are more or less complex according to the greater or lesser complexity of the organization of the body. This is a banality if considered from the point of view of modern knowledge, but it was Lamarck who made it a commonplace. Indeed, it was no such thing at the time, since other possibilities did not exist. If one was a materialist, one was a mechanist (since there were no other forms of materialism apart from the «*mechanist philosophy*»); thus one was driven into the blind alley of attempting to understand even the most complex vital phenomena by making exclusive reference to the quantity, form and particular assemblage of atoms in movement. If one was not a materialist, one was an animist; in this case, one shared an essentialistic definition of «*life*» which, governed by the "all or none" principle, made it impossible to understand the variety of vital manifestations. Or, one gave an appearance of a "third way" between mechanism and animism —that of vitalism, inspired by the research program of the Montpellieran doctors. However, this paradigm did not lead too far from the others since it turned into a tautology (the living being is neither a machine nor the possessor of a soul, but rather the individual that possesses a «*vital principle*»), and into a tautology that referred to a dimension of the soul certainly more "lay" than Christian tradition, but just as impalpable and equally elusive to empirical assessment.

That of Lamarck, taken in *Flore française* (1778), is a true "third way", which allows one to be materialist without falling back on the «*mechanist philosophy*». It is the way of organistic (today we would say holistic) materialism, which consists of assuming that life is an emerging property of the aggregate of matter —a property *of order* or *of system*. Reflecting perhaps on some experimental data of the «*new chemists*»,[7] Lamarck came to deny what the mechanists had repeated for centuries and was

[7] And perhaps, in particular, of Lavoisier, who had observed that the properties of the elements are not always preserved in compounds, where instead they «are transformed» («are converted») or even

the basis of each of their working hypotheses: that the properties of the whole are nothing but the sum of the properties of the components. In contrast, he maintained that, by combining, matter acquires new properties: «*each compound can vary infinitely in its state of combination (...) After each modification, be it large or small, matter will have, necessarily, particular properties relative to its new state*» (Lamarck 1802, p. 71). Life for Lamarck is an emerging property in the sense that it is «*a product of organization*» (Lamarck 1814, p. 232): therefore, certainly a material dimension, but of a nature that recalls an *ad hoc* materialism, much more sophisticated than mechanist materialism and, in contrast to it, anti-reductionist.

Life is «*a product of organization*». This Lamarckian solution was original and for a long time Lamarck was isolated for having proposed it. Indeed, in those years the opposite orientation was unanimously shared: that which led Diderot, always lucid in catching the spirit of the era, to maintain: «*imagine the three molecules A, B, C: if they are without life in the combination A, B, C, why would they ever begin to live in the combination B, C, A or C, A, B?*» (Diderot 1765, p. 8). In effect, there was no way of imagining it at the time. Yet despite encountering many difficulties and authoritative resistance, and though proceeding only with theoretical arguments, Lamarck began to do so. He was the first to think, *mutatis mutandis*, of what geneticists would call «*the position effect*». He knowingly posed this new principle as the basis of his redefinition of the concept of life and, more generally, of the foundation of biology as an independent science: because it allows one to think that life can 'emerge' from matter without the intervention of any principle foreign to the matter itself, and it ensures that biology can 'emerge' from physics without the risk of taking the form of a metaphysics.

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«are lost» («disappear») only to «reappear» («be reborn») at times in subsequent combinations, and that new properties, not possessed by the elements, «are acquired» (see LAVOISIER, A.L., 1777-1779, 1785).

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