Journal of the History of Biology (2011) 44:713–744
DOI 10.1007/s10739-010-9240-x

French Roots of French Neo-Lamarckisms, 1879–1985

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Abstract. This essay attempts to describe the neo-Lamarckian atmosphere that was dominant in French biology for more than a century. Firstly, we demonstrate that there were not one but at least two French neo-Lamarckian traditions. This implies, therefore, that it is possible to propose a clear definition of a (neo)Lamarckian conception, and by using it, to distinguish these two traditions. We will see that these two conceptions were not dominant at the same time. The first French neo-Lamarckism (1879–1931) was structured by a very mechanic view of natural processes. The main representatives of this first period were scientists such as Alfred Giard (1846–1908), Gaston Bonnier (1853–1922) and Félix Le Dantec (1869–1917). The second Lamarckism – much more vitalist in its inspiration – started to develop under the supervision of people such as Albert Vandel (1894–1980) and Pierre-Paul Grassé (1895–1985). Secondly, this essay suggests that the philosophical inclinations of these neo-Lamarckisms reactivated a very ancient and strong dichotomy of French thought. One part of this dichotomy is a material, physicalist tradition, which started with René Descartes but developed extensively during the 18th and 19th centuries. The other is a spiritual and vitalist reaction to the first one, which also had a very long history, though it is most closely associated with the work of Henri Bergson. Through Claude Bernard, the first neo-Lamarckians tried to construct a mechanical and determinist form of evolutionary theory which was, in effect, a Cartesian theory. The second wave of neo-Lamarckians wanted to reconsider the autonomy and reactivity of life forms, in contrast to purely physical systems.

Keywords: neo-Lamarckism, French biology, experimental transformism, mechanism, vitalism, French philosophy

Introduction

French biology has had a distinguished history in the past three centuries, from Buffon to Claude Bernard, and from Louis Pasteur to François Jacob. However, it is a fact that French scientists did not much participate in the construction of the main theory in biology, the *Evolutionary Synthesis* (Mayr and Provine, 1998). This construction mostly occurred during the 1920–1950 period. Such a situation is often explained by the opposition of French biologists both to neo-Darwinian conceptions and to Mendelian genetics, mostly because of Lamarckian inclinations (Boesiger, 1998, pp. 309–328; Bowler, 1992, pp. 107–117). This statement, as far as it goes, is true. The first opposition – or at least misinterpretation – of French biologists to Darwinism has been well documented by Yvette Conry for the period 1859–1900 (Conry, 1974). The underdevelopment of genetics has also been deeply studied (Burian et al., 1988). Richard Burian, Jean Gayon and Doris Zallen establish that the "dominance of the physiological, embryological, and microbiological traditions in France is central to a proper explanation of the anti-Mendelism that characterized French biology before World War II" (*Ibid.*, p. 358). In this paper, I try to examine the other side of the same story, that is, the historical and philosophical reality of what is called neo-Lamarckism in France.

It still remains quite difficult to assign a precise period to this neo-Lamarckian tradition, especially when you consider the possibility that there were not one, but two distinct French neo-Lamarckian schools of thought. In a previous treatment (Loison, 2008b), I considered the article of Edmond Perrier (1844–1921) "Le transformisme et les sciences physiques" (1879) as the starting point of a French materialist transformism – where "transformism" can be treated as a synonym for "evolutionary theory." This transformism was highly influential during the 1880s and the 1890s, because of its experimental claims. After a very confused period (1910–1930), however, this kind of conception slowly disappeared. The turning point was probably the important book published in 1931 by Maurice Caullery (1868–1958), *Le problème de l'évolution*, which ratified the failure of this conception. Following this period, a second kind of transformism – much more vitalist in his inspiration – started to develop, under the supervision of people such as Albert Vandel (1894–1980) and Pierre-Paul Grassé (1895–1985). This second neo-Lamarckism had a major impact in French biology, at least until the death of Grassé. Taking these two forms of evolutionary theory together, in this article, I will discuss this history of evolutionary concepts in France over the entire

period, 1879–1985. I will first try to give a synthetic characterization of these transformisms, in order to make clear their basic opposition. I will then examine the historical roots of these conceptions of life. This examination will show that they were both French in their philosophical inspiration, but that neither needed Lamarck's ideas to emerge.

From Alfred Giard to Pierre-Paul Grassé, Two Conceptions of the Evolutionary Phenomenon

How to Define (Neo) Lamarckism?

Although it is very classical to oppose Darwinism and Lamarckism, it is still quite difficult to define these conceptions without referring to their opposition. Of course, people generally focus on the acceptance of "soft inheritance" to characterize a Lamarckian evolutionism and this is a good vantage point, but it leaves out too much to have real value as an explanation of the historical trends. Many scientists who believed in the inheritance of acquired characters were not Lamarckians, nor even evolutionists (Gayon, 2006). Charles Darwin himself was a partisan of this kind of inheritance, but reading *The Origin of Species* must convince anyone that his global conception of evolution was not a Lamarckian one. Closer to our time, French zoologists like Albert Vandel or Pierre-Paul Grassé denied the reality of soft inheritance. Yet, I maintain that it is still appropriate to see them as neo-Lamarckian biologists.

Hence, the problem is to propose a theoretical definition of Lamarckism that will be fruitful to understand the actual history of ideas about transformism in France. In another text (Loison, 2008b), I proposed defining Lamarckism by the way scientists understood the nature of *individual variation*. If individual variation is understood as an *effect*, then the global conception in which the explanation takes place can be called Lamarckism. Therefore, Lamarckisms are causalist transformisms. When individual variation is an effect, it is then necessary and legitimate to try to understand its causes (its "factors"), because by extension, the cause of the individual variation is the cause of the entire phyletic evolution. See how Alpheus S. Packard (1839–1905) – who assumed a leading role in the genesis of American neo-Lamarckism (Pfeifer, 1965, p. 157) – emphasized this point in his biography of Lamarck (1901), when he strongly opposed the idea that natural selection could be an evolutionary cause: "It was perceived by some that natural selection by itself was not a *vera causa*, an efficient agent, but was passive, and rather expressed the results of the operations of a series of

factors. The transforming should naturally precede the action of the selective agencies (Packard, 1901, p. 383).''

A Lamarckian conception is always a reductionist explanation, which looks for the key of evolution into the individual organism itself. Variation is understood as an individual *process* (in time) and therefore natural selection is only of secondary importance.

On the contrary, for Darwinians, the individual variation is not of evolutionary value *per se*. In classic Darwinian evolutionary biology, the way phenotypes are constructed was effectively ignored. Only the differences of fitness of phenotypes in a population drew the attention of the traditional Darwinian evolutionist. Hence, individual variation is understood as a precondition, because it initiates the selection process by making the diversity possible. The specific way the variation occurs is not a matter of interest – as Gould emphasizes (Gould, 2002) – so long as variation is copious, individually small in phenotypic effect and undirected. Variation is seen as a *state* in a population context (in space). The real cause of the evolutionary change can only be the natural selection.

If one accepts this theoretical demarcation between Lamarckism and Darwinism, it becomes possible to characterize two main types of Lamarckian thought that was featured in French biology from the late 19th century through most of the 20th. These two kinds of Lamarckisms take us to back a very old and very classical alternative in biology: function and structure. When the cause of the individual variation is looked for outside the organism, in the physical and biological environment, then the explanation of evolution rests mostly on the idea of adaptation: it is the function that drives the course of evolution. On the other hand, when the cause of variation is looked for inside the organism, the explanation focuses on internal laws of development and structural constraints: it is a force from the inside which becomes the main organizer of the evolutionary process. In both cases, the key element in evolution is the nature of individual variation so the explanation must look for the causes of variation.

This dichotomy, I propose, existed in French biology. I think that, originally, French transformism was an adaptive Lamarckism (1879–1931), where the ''milieu'' was seen as the main and powerful cause of organic evolution. During the 1910–1930 period, however, the reality of soft inheritance was strongly challenged, and finally scientists had to accept – even in France – that this kind of heredity did not exist, at least in present-day nature. At the end of this very confused period, another kind of transformism started to develop, which was much more a structuralist Lamarckism (1931–1985).

The Adaptationist Conception of the First French Neo-Lamarckism (1879–1931)

Notably because of positivist inclinations, the evolutionary hypothesis was hardly accepted in France,[1] even after the translation of Darwin's main book (1862). It was thus necessary to wait until the late 1870s and the 1880s to see transformism become the dominant theoretical background of zoological and botanical studies. In zoology, Alfred Giard (1846–1908) and Edmond Perrier were of prime importance. Their work and teaching – at the Sorbonne for Giard (from 1888 to 1908, when he was called to a new chair of evolutionary studies (Viré, 1979)), at the Museum of Natural History for Perrier (from 1876 to 1921) – imposed evolutionism as the only scientific interpretation of the living. At the same time, Gaston Bonnier (1853–1922) and Julien Costantin (1857–1936) did the same in botany. Bonnier was one of the most esteemed biologists in France at the end of the 19th century (he was professor at the Sorbonne from 1887 to 1922), and his acceptance of a Lamarckian transformism was therefore of great importance to the engagement of many scientists in this "new" conception of life.

I have already developed the history of this critical period, when at last transformism was finally accepted in France (Loison, 2008b; Loison, to be published). I will now only emphasize the main characteristics of this first French neo-Lamarckism. The first thing to say is that this transformism tried to develop as an *experimental* science. That means that compared to the theory of Darwin – and afterwards to August Weismann – French biologists wanted to establish the reality of life transformability on experimental proofs. For example, the zoologist Henry de Varigny (1855–1934), who had an important part in this history because of the numerous translations in French that he did (Weismann, etc.), declared in 1891[2] (de Varigny, 1891, pp. 770–771):

[1] Loison, to be published. For a different presentation see also Farley (1974) and Bowler (1992). For a complete and exhaustive survey, see Conry (1974).

[2] My translation.

"Nous possédons des faits d'observation; il nous faut des faits d'expérience; il faut le transformisme expérimental, c'est-à-dire l'application de la méthode expérimentale à l'étude de l'évolution. Il nous faut non seulement provoquer les phénomènes au lieu de les attendre, et, les provoquant par des moyens déterminés, arriver à connaître leurs causes; il faut encore orienter tous les moyens d'action dont nous disposons déjà, et ceux que nous pourrons découvrir, dans une même direction, et les faire servir à ceci : transformer expérimentalement les êtres vivants, déterminer les conditions sous lesquelles la transformation s'opère, et mesurer en quelque sorte le degré de celle-ci. De cette enquête il ne peut découler que des résultats du plus haut intérêt."

> We have facts of observation; we need facts of experiment; we need experimental transformism, it is to say the application of the experimental method to the study of evolution. It is necessary not only to cause phenomena instead of waiting for them, and, by causing them to determine ways to be able to know their causes; it is also necessary to direct all the means of action that we already have, and those that we will be able to discover, in the same direction, and make them be used for this: to transform experimentally living things, to determine conditions of transformation, and to measure its degree. From this investigation, only the most interesting results will be obtained.

Since the beginning of the 1880s, several experimental programmes were led in numerous fields of biology (botany, teratology, and microbiology at the new Pasteur Institute) in order to achieve this ambition. The procedures were quite always the same: the physico-chemical environment of organisms was quantitatively changed and the biological consequences measured with precision. This experimental phase (1880–1910) must be seen as the most active one in the history of French Lamarckisms. Among all these experimental attempts, it was in botany that the most spectacular results were obtained, mostly under the supervision of Gaston Bonnier and Julien Costantin. They performed a huge program of experimentation, which started when Bonnier came back from a journey in Sweden and Norway (1878). During his stay, he persuaded himself that plants could be drastically modified in their morphology, anatomy and physiology by changing abiotic parameters like luminosity, temperature and humidity (Bonnier and Flahault, 1878). In 1882, he started to perform many experiments in the French Alps. Cuttings of the same seedling were planted at different stations (from 1060 to 2030 meters altitude) and in his laboratory near Paris (Fontainebleau). The results showed clearly that it was possible to directly cause variation by changing growing conditions (Bonnier, 1895). By extension, it seemed reasonable to explain the entire evolutionary change by the simple addition of these kinds of individual variations (Bonnier, 1907). At the same time, Julien Costantin carried out a laboratory work at the Ecole Normale Supérieure, in order to clarify Bonnier's results by performing experimental transformations of different organs. He first observed that a stem could be transformed into a root by cultivating it under a mass of thick soil (Costantin, 1883). He also obtained interesting results by pushing plants into the water during their growth, experimental protocol that led to the disappearance of stomata (Costantin, 1886). All this research was supposed to reinforce

the idea that organisms were under the complete domination of their powerful milieu (Costantin, 1898).

Such an idea was also greatly strengthened by the development of marine biology: many types of new organisms were discovered during these years, and they show, in their morphology, anatomy and physiology, how strong the effects of the environment can be. I insist here on the importance of the marine station of Wimereux, in the north of France, which was created by Giard in 1874. This laboratory welcomed many of the French transformists, at least until the death of the master (1908).[3] Among the numerous works that were performed in this station until its destruction during World War II, those concerning parasitism were of prime importance. By showing the drastic transformations that evolved because of this way of life, they participated to convince that living things could not escape the actions of the environment. For example, the classical work of Giard and Jules Bonnier (Giard and Bonnier, 1887) on the morphology, embryology and biology of *Cepon* and *Entonisci* (marine crustaceans) was very influential in France at the end of the 19th century (Perrier, 1891). It illustrated largely how much the morphology of the host could be modified by the direct physiological impact of the parasite – the main factor of its milieu.

Hence, because of the diversity of environments in which organisms can evolve, the evolutionary process has to be a complex branching tree. If the main factor of evolution is adaptation, the phylogeny of life forms has to be non-directed. In addition, for most of these biologists (except for Edmond Perrier), this consequence of their comprehension of the dynamic of life transformation is clearly illustrated by the diagrams they proposed to represent the evolutionary pattern. See, for example, the phylogeny that Alfred Giard used to present to his students when he became professor at the Sorbonne (Figure 1). This tree of life does not represent vertebrates as the ''higher'' forms of living things – as Haeckel did –, but just as one of the possibilities followed by organic evolution.

The second point that must be underlined is the way these biologists understood the term ''milieu.'' According to them – and in opposition to Darwin – the milieu was almost reduced to the physical and chemical environment of the living (it was called ''les milieux cosmiques''), including the nutritious relationship between the host and the parasite. Therefore, causes of evolution had to be physical and material causes. This comprehension of the milieu was very close to the original definition of this concept, which was at first a mechanical one (Canguilhem,

[3] Conry (1993). For a complete but quite unclear survey on Giard's disciples, see also Bouyssi (1998).

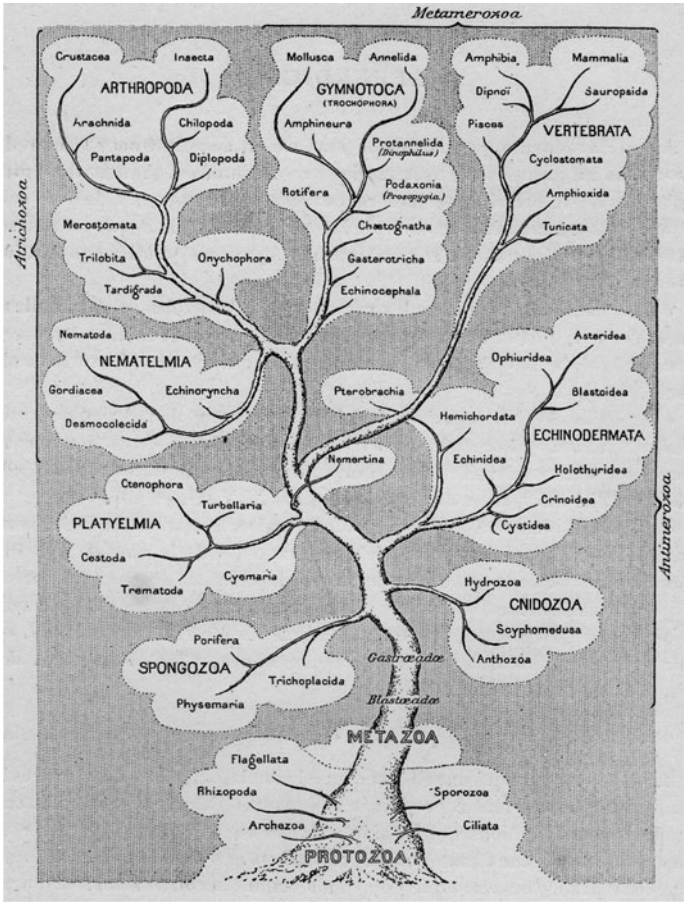

Figure 1. Phylogenetic tree constructed by Alfred Giard in 1889.

2003). Of course, this theoretical choice was not innocent: these biologists wanted to build a material and mechanical science of the living in order to achieve the development of biology as a "real science." That is why they were clearly not interested in biogeography and in biotic relationships between organisms, hence, in neo-Darwinian themes of research.

These theoretical inclinations have many levels of explanation, and I will discuss some of them in the second part of this paper. For the moment, I would just like to recall that Claude Bernard was the main and direct influence on these biologists, as already noted by Bowler and Conry (Bowler, 1992, p. 112; Conry, 1993, p. 511). French neo-Lamarckians of this first period tried to be faithful to the education of their

master and wanted to construct an experimental transformism similar to the experimental physiology of Claude Bernard. This influence was decisive in the way evolution was studied at that time in France. In 1867, Claude Bernard himself proposed that the experimental method, at first developed in physiology, must be an important tool to study the way biological heredity could be modified[4] (Bernard, 1867, pp. 112–113):

> Under the influence of cosmic conditions and varied modifying influences, the living organism is still capable of acquiring during its life normal or morbid varied abilities, which can then be passed on by the organic state, that is to say by heredity. It is therefore first with these cases, which are the easiest to observe, that the *experimenter physiologist* will have to focus on and concentrate his studies, in order to determine the physiological mechanism by which nutritive modifications imparted to the parents can be transmitted to the descendants under certain defined conditions.

Confident in the possibilities of the experimental method, convinced that organic evolution was first a physiologic and adaptive phenomenon, French neo-Lamarckians reduced evolutionary change to individual physiological variation. Hence, they were forced to admit the efficiency of the inheritance of acquired characters.

A Transition Period (1910–1931), the Problem of the Inheritance of Acquired Characters

Following this first experimental phase, the 1910–1930 period was a very confused and unhappy one, because despite the huge number of experiments, the reality of the inheritance of acquired characters could not be ascertained. In effect, the claim that an experimental demonstration of evolution could be achieved – in a physiological sense – had

[4] My emphasis and my translation.
"Mais l'individu vivant est encore capable d'acquérir pendant sa vie, sous l'influence de conditions cosmiques et de modificateurs divers, des aptitudes variées normales ou morbides, qui peuvent ensuite se transmettre par la tradition organique, c'est-à-dire par l'hérédité. C'est donc d'abord sur ces cas, qui sont les plus faciles à observer, que le physiologiste expérimentateur devra porter son attention et diriger ses études, afin de déterminer le mécanisme physiologique à l'aide duquel les modifications nutritives imprimées aux parents arrivent à se transmettre aux descendants sous certaines formes déterminées."

failed. To look for the existence of soft inheritance was at that moment very attractive for many scientists all across Europe and the United States, and should not be seen as a peculiarity of the French community (see for example Detlefsen, 1925). Of course, the results were very disappointing for most of the French scientists, because of the general importance of their Lamarckian beliefs. During the 1920s, more and more French biologists started becoming sceptics about the possibility of studying the mechanisms of evolution through a classical scientific approach (i.e. an experimental and physiological one).

The zoologist Maurice Caullery, the successor of Alfred Giard in the "Chaire d'évolution des êtres organisés" at the Sorbonne (1909–1939), summed-up the French thought of the time in his very important book, *Le problème de l'évolution* (1931). The problem, as he insisted in the introduction, was not evolution itself. The fact of evolution was indisputable because of anatomic, embryologic, cellular, and paleontologic arguments. The way that evolution proceeded, however, remained unknown, and even worse, might be unknowable (Loison, 2008a). In his view, like most of the French biologists during this period, natural selection could not be the main factor of organic transformation. In addition, because he was not able to conceive phyletic adaptation without the mechanism of inheritance of acquired characters, he tried to save his conceptions by arguing that the lamarckian mechanism had to be efficient in the past. This could explain the failure of actual attempts to demonstrate the reality of lamarckian heredity. However, this also forced his neo-Lamarckism to become an ideological position, unable to be tested in present-day nature. Caullery's final renunciation must be taken seriously by historians about the way evolution was understood in France at that time: a strictly physiological and individual process.

During the same period, Etienne Rabaud (1868–1956) had to modify his views in a different way. At first a student of Camille Dareste (1822–1899), he developed the teratologist programme of his master during the late 1890s. Around 1900, after he joined Giard's laboratory at the Sorbonne, he was deeply convinced that the study of developmental abnormalities was the key to understand the evolutionary process (Rabaud, 1908). Then, like Caullery, he slowly had to change his mind, also mostly because of the failure to demonstrate soft inheritance. During the late 1910s, he developed an alternative solution to this problem. In opposition to Caullery, he chose to renounce to the idea that morphological adaptations were important features of living things. In his important book *L'adaptation et l'évolution* (1922), the transformation of his beliefs was complete: according to him,

morphological adaptation is only an artefact, and thus, it became irrelevant to construct a hypothesis in order to explain it[5] (Rabaud, 1922, p. 71):

> The illusion comes from the fact that adaptation is usually considered only from the morphological point of view. In an organism, it is the form that draws first the attention and observers naturally tend to subordinate everything to anatomic dispositions. This mistake takes us to the impasse in which we are committed: having established as a principle the agreement between forms and conditions, we are not able to explain the origin of this agreement. Hence, our confidence in the value of the principle becomes strongly shaken; we are led to examine it closer, and this new examination incites us to abandon it, to deny that the agreement of forms and conditions is a necessary fact.

These modifications led the first French neo-Lamarckism to a kind of explanatory impotence during the 1920s and the 1930s, because it was no longer able to explain adaptation, which was at first the main project of the experimental transformism. That is why this Lamarckism slowly disappeared around 1940, as its last supporters were growing old (Rabaud died in 1956 and Caullery in 1958).

The Structuralist Conception of the Second French Neo-Lamarckism (1931–1985)

It was at that time that another Lamarckism started to emerge in French thought, and soon became dominant. This "new" transformism was both a reaction to the mechanical perspective of the old one, and a non-Darwinian possibility that did not need the inheritance of acquired characters to exist. The two main representatives of this Lamarckism were Albert Vandel and Pierre-Paul Grassé. Each had his own speci-

[5] My translation.
"L'illusion provient du fait que l'adaptation est généralement envisagée d'un point de vue assez étroitement morphologique. Dans un organisme, la forme attire dès l'abord l'attention et les observateurs inclinent très naturellement à tout subordonner aux dispositions anatomiques. L'erreur commise nous mène à l'impasse dans laquelle nous nous trouvons engagés : ayant établi en principe la concordance des formes et des conditions, nous ne parvenons pas à rendre compte de l'origine de cette concordance. Du coup, notre confiance dans la valeur du principe se trouve fortement ébranlée; nous sommes conduits à l'examiner de plus près, et ce nouvel examen nous détermine à l'abandonner, à nier que la concordance des formes et des conditions soit un fait nécessaire."

ality, but they were both recognized as brilliant scientists, who had almost a complete knowledge of the zoology of their time.

Albert Vandel, after a Ph.D. thesis on the regeneration abilities of the planairia (1921), became a specialist of the group of isopods, some small terrestrial crustaceans (like wood lice), many of which live in very dark environments, like underground caves (Vandel, 1953). In order to study these animals, he founded a laboratory near Toulouse (in Moulis), after becoming assistant professor in this university in 1923 (he became professor of zoology in 1927 and stayed in Toulouse until his death). Because of these zoological studies, Vandel had to pay attention to the question of adaptation. After performing many experiments on both animals coming from caves and others coming from the normal terrestrial situation, he was forced to conclude that present organisms were not the result of a long period of evolution by inheritance of acquired characters (at least not in the simplest sense his masters believed), and thus concluded that all "these facts are in contradiction with the lamarckian interpretation" (Vandel, 1938, p. 142). Hence, the main factor of evolution could not be the direct intervention of the environment. Vandel was more and more convinced that this kind of transformation, from epigean forms to albino and blind ones, were the results of an internal and orderly process (*Ibid.*, p. 144):

> The facts provided by systematic, ecology and genetics are successively examined. It appears that cavernicolous species are the result of a series of similar mutations to that of *alba* and *pallida* mutations observed in the breeding experiments. These mutations must have produced themselves according to a determined order, the same regressive series (loss of pigment in the body, the regression of the eye) being noticed among the different phylums.

This scientific statement, published in Alfred Giard's journal (*Bulletin biologique de la France et de la Belgique*), will be quickly integrated in a more complete view of life's dynamic, where an internal force of transformation became the primary motor of the evolutionary process.

Pierre-Paul Grassé, the successor of Caullery at the Sorbonne (1941–1967), was at first a student of Vandel, when he came back from World War I and started studying biology in Paris (Grassé, 1958a) in the very poor and small laboratory of the "Chaire d'évolution des êtres organisés" (Estrapate street, near the Pantheon). He left a profound mark on French science (Wolff, 1986), as a great zoologist with an encyclopedic knowledge, and as an intransigent (some would say tyrannical) mandarin, who succeeded in imposing his beliefs because of his scientific position.

As a zoologist, his first work concerned some aspects of the biology of protozoa, under the supervision of Octave Duboscq (1868–1943), one of the most esteemed protozoologists of his time. His Ph.D. work was devoted to the study of some parasitical flagellates (1926). Because he was very interested in symbiotic relationships and parasitism, he continued studying the flagellates that live inside the digestive tract of termites. Turning from the symbiot to the host, he became then one of the most esteemed specialists of the zoology of termites. His studies on isoptera involved much work on social relations among animals, work that was decisive in his opposition to neo-Darwinism (Grassé, 1948) and at the end of his life to socio-biology.

Vandel and Grassé's conceptions about evolution were not identical, but they were sufficiently close so that they can be treated together. The first thing to notice is the perfect continuity of the history: Vandel was a student of Caullery at the Sorbonne and was always very indebted to his first master (Vandel, 1958, pp. 46–47); Grassé was at first in direct contact with Rabaud when he arrived in Paris (Grassé, 1958b). Despite this similar conceptual background, each of them developed a transformism that was very far from the adaptive and mechanical one their mentors had supported. The second thing, which must be emphasized, is that for both of them, evolution was the hardest (and most interesting) problem in life sciences. That means that to be able to have a well-grounded opinion about evolutionary mechanisms, one must first be a real naturalist, which is a complete scientist who tries to have the most exhaustive knowledge of biological and paleontological facts (Vandel, 1949, p. 23). Indeed, Vandel and Grassé were naturalists, and they knew much more than their own scientific fields of research strictly required. This point is important because they always reproached neo-Darwinians for being only "theoreticians," that is to say, scientists who are not really aware of the complexity of nature (Grassé, 1973, p. 9).

Furthermore, because of their paleontological knowledge specifically, they insisted that macroevolution was a very orderly phenomenon, showing trends and even purpose through a complicated transformation of life (Vandel, 1949, p. 23; Grassé, 1973, p. 28). They always insisted about the necessity of the idea of finality in the field of biological science. For both of them, to eradicate finality from biology was a vain attempt because it went against reality itself. The appearance of *Homo sapiens* was therefore understood as the necessary (but temporary) end of organic evolution. Obviously, it was impossible for them to explain such a finalistic sequence only by random mutations and natural selection. This point was reinforced by their very poor

conception of the working of natural selection, which was much too simplistic, in other words, they reduced it to the elimination of the unfit. That is why they were looking for something more than just a local and adaptive motor for the evolutionary process. The *primum movens* of evolution was not diversification because of adaptive necessity, but complication from one structural level to the next. The phylogenetic diagram that Vandel published in 1949 illustrated this conception of evolution as a progressive sequence (Figure 2).

The main cause of variation should not be sought in the environment, but inside organisms: a kind of internal force must drive evolution from the inside, through geological time, and despite the diversity of local environments[6]: "The term of evolution points to the succession and the variation in time of vegetal and animal forms. It implies that, to the parental continuity, an *internal trend* to modify some structures and to create new ones is added" (Grassé, 1973, p. 17).

To explain how Vandel and Grassé precisely conceived this internal trend is very difficult because they were both quite confused about this critical point. According to them, this force was not a purely physical one. They imagined that, in one sense or another, evolution was driven by something like a spiritual determinism. That is to say that they were both in complete opposition to the radical materialism of the first Lamarckians. Their vitalist conception – even if they were reluctant to use this term – was also clearly linked with theological purpose, which was also a matter of opposition with the first Lamarckians, some of who were explicitly atheist. This metaphysical opposition was generally recognized and assumed by Vandel and Grassé. For instance, Grassé wrote that Alfred Giard was a "foolish anticlerical" (Grassé, 1973, p. 277), and did not hide his personal beliefs about God (he used to write articles for the journal *France catholique*).

The internal and spiritual force, which was supposed to drive the entire phylogenetic process, was a necessary cause for the variation to be really an evolutionary novelty. Vandel and Grassé were strongly opposed to the idea that genetic random mutations could be the material basis of real macro-evolutionary improvements. Macroevolution had to be something much more complicated and much more *creative* (literally) than what microevolution could offer. Because of this internal and structural determinism, evolution should be able to continue in different

[6] My emphasis and my translation.
"Le terme d'évolution biologique désigne la succession et la variation dans le temps des formes végétales et animales. Il implique, qu'à la continuité parentale, s'ajoute une tendance interne à modifier certaines structures et à en créer de nouvelles."

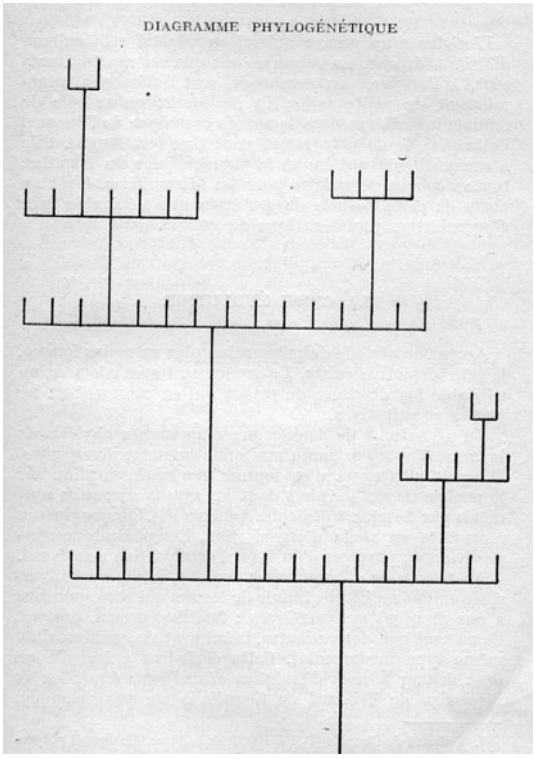

Figure 2. Phylogenetic diagram proposed by Albert Vandel in 1949. It illustrated a view of evolution as a progressive process, from one structural level to another. Compare this diagram to the phylogenetic tree of Alfred Giard (Figure 1).

lineages, following the same general trends in different environments. Grassé was convinced that the evolution of Mammals was a perfect illustration of this phenomenon (Grassé, 1973, pp. 57–104; see Figure 3).

However, this did not mean that their conception was a strictly orthogenetic one. They assumed that evolution was a more complicated process, not something that unfolded in a straight line, each lineage showing a possibility of achieving its morphological purpose, or its "iodiomorphon" like Grassé used to say. This "French" evolutionism – as they recognized it (Grassé, 1958a, p. 33) – was very influential in France until the death of Vandel (1980) and Grassé (1985).

This synthetic comparison between these two forms of Lamarckism must convince one that they were in complete opposition. The first one was a materialist and adaptive transformism, when the second one was more a spiritualist and structuralist conception. This opposition is even

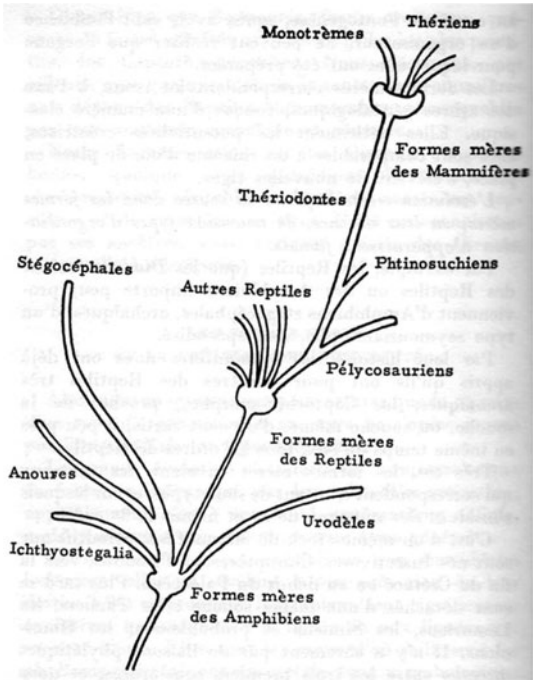

Figure 3. Phylogenetic diagram proposed by Pierre-Paul Grassé in 1973 in order to explain the evolutionary sequence that led to mammals.

more surprising when you observe the perfect institutional continuity from Alfred Giard to Maurice Caullery, and Maurice Caullery to Pierre-Paul Grassé. One of the explanations of such an overthrow, as we see, was the impossibility to assure the reality of the inheritance of acquired characters. Bowler also insisted on the fact that lamarckians from the 1900–1930 period were not able to propose a theoretical structure capable of guiding detailed and experimental research (Bowler, 1992), a point that will be enlarged in the conclusion of this essay. In France, this situation was reinforced by the extreme centralization of science. If a few protagonists of this history decided to explore "other forms" of explanation, they had to influence a huge part of the biologists of their time: this is what happened when Vandel, and furthermore Grassé, reached the top of the academic system.

I will now discuss other and complementary hypotheses that might contribute to explain such a situation. In the next part, I argue that this dichotomy reflected a very old and strongly grounded philosophical bipartition of French thought, which was reinforced and actualized by

the publication of *L'Evolution créatrice* in 1907. In their own way, Grassé and Giard replayed the drama of Bergson versus Descartes.

Descartes and Bergson, or the Significant Bifurcation of French Thought

Bowler and Conry have already noticed that the first French neo-Lamarckians "opted for an explicitly materialistic world view derived from Descartes' mechanical philosophy" (Bowler, 1992, p. 112). In this part, I would like to develop this statement by clarifying the structure of this materialistic view, which became the implicit – but strongly grounded – metaphysics of these scientists. To understand this point is essential in order to appreciate the major impact of Bergson's book – *L'Evolution créatrice* – on French biology. In 1907, the first mechanical lamarckism began to weaken so the new generation of biologists had to develop both another kind of evolutionary explanation and another metaphysics to support it. By doing this, they reinforced the bipartition of the French thought, torn between the mechanical point of view inherited from Descartes and the vitalist one re-activated by Bergson.

Epistemologically speaking, this dichotomy had a great influence on French philosophy of science too. It is indeed quite traditional to present French philosophy – and especially French philosophy of science – as a dual entity (at least during the 19th and 20th centuries (see for instance Foucault, 2008; Worms, 2009)). On the one hand, a Cartesian conception of knowledge existed. This is a philosophy "of the concept": every phenomenon – including vital ones – can be interpreted as a strictly mechanical fact, and so could be understood by the classical scientific mechanistic concepts of the rational intelligence. On the other hand, as an answer, a philosophy "of the subject" was developed during the last two centuries. According to these philosophers, science (i.e. physics) is not the ultimate explanation to all phenomena. Vital and spiritual phenomena are too complicated and susceptible to much spontaneity and finality to be understood by the physical intelligence. That is why our reason has to give in to our personal intuition. Around 1900, Henri Bergson was the most famous supporter of this kind of vitalist philosophy, but not the only one.

In this part, I would like to show how well this dichotomy fits French Lamarckisms. The existence of links between Descartes' philosophy and the first neo-Lamarckism on one hand, and Bergson's philosophy and the second neo-Lamarckism on the other hand, should contribute to

explain both the duality of French Lamarckisms and their inscription in a French tradition of thinking.

The First Neo-Lamarckism: A Bernardian Science with a Cartesian Metaphysics

The first neo-Lamarckians, like Gaston Bonnier, were sometimes explicit about their scientific purpose: they worked in order to extend the physiological experimental science of Claude Bernard to morphological and evolutionary problems (Bonnier, 1893). Their scientific procedures were directly derived from the physiological field, and were performed in order to find out the *determinism* (a very Bernardian concept) of organic individual variation, and by extension, the "causes" of the whole evolution. The Bernardian root of this transformism is an undisputable statement, but which remains insufficient to provide a complete understanding of this first neo-Lamarckism.

I put forward the idea that their global conception of life was established on two main, more or less, implicit axioms: (1) *biological organisms are pure mechanisms*, (2) *the entire world is a "full" entity*, that is to say that any part of the universe is in a complete and deterministic relation with all others (the milieu). This hypothesis links the first French neo-Lamarckism to the Cartesian tradition and explains why these biologists were convinced that the milieu was the main motor of organic evolution.

Of course, this Cartesian conception knew different embodiments during this period (1879–1931). A very complete working out can be found, for instance, in the works of Félix Le Dantec (1869–1917), the most famous student of Alfred Giard (for example, see Le Dantec, 1907). He developed his mechanical conceptions to a very large extent in more than 40 books! Reading these books must convince one of the importance of the mechanical comprehension of natural processes for these scientists. Even the term "mechanics" can be found everywhere in this literature. For example, in 1913, Le Dantec still published a book entitled *La "mécanique" de la Vie*.

Yet, one of the "hardest" mechanisms was certainly the one worked out by the zoologist Frédéric Houssay (1860–1920) around 1900. Like Giard and Perrier, he was at first a student of Henri de Lacaze-Duthiers (1821–1901), one of the last supporters of fixism in France. In 1907, he became professor at the Sorbonne, and started working on the morphology of fish at the marine station of Roscoff (created by Lacaze in 1872). His theory was that the typical hydrodynamic shape of most of

the fish is the result of the repeated mechanical action of hydrodynamic forces on a very plastic body, over geological time (Houssay, 1912, pp. 7–8). This adaptive conception brings about the disappearance of the individuality of the living: the individual organism appears to be completely dominated by the physical forces of its milieu. It becomes an automaton, in a very Cartesian way, as Georges Canguilhem had already noticed (Canguilhem, 2003, p. 173). The biological organism is nothing more than a kind of local (in both time and space) event in a continuous and full material universe[7] (Houssay, 1912, p. 328):

> For myself, facts tell me that every thing in the Cosmos and especially a living thing is the result of everything happens everywhere, in it and around it; it is impossible for me to consider something aside and in itself. If to understand the fish, I believed I had to study the water, then, to understand any living thing, I will always, as a method, have to study its milieu.

Biology must then be united with physics. The idea that the entire universe was a kind of full entity was explicitly recognized by others neo-Lamarckians, like Edmond Perrier (Perrier, 1881, pp. 10–11) or Jean de Lannesan (de Lanessan, 1883, p. 72). A very important consequence of this metaphysical positioning was that it implies necessarily that the action of the environment reaches the germ plasm, which cannot be taken away from outside forces. Therefore, the inheritance of acquired characters must be an effective mechanism in the evolution of species.

Descartes himself was sometimes explicitly mentioned by these biologists when they described their general beliefs. Above all, he was always presented as the real founder of the evolutionary thinking, because he was the first to develop a material explanation of the formation of the entire universe[8] (de Lanessan, 1914, pp. 107–108):

[7] My translation.
"Pour mon compte les faits me disent que chaque chose du Cosmos et notamment un être vivant est le résultat de tout ce qui se passe partout, en elle et autour d'elle; il m'est impossible de rien considérer à part et en soi. Si pour comprendre le poisson, j'ai cru devoir surtout étudier l'eau, pour comprendre n'importe quel vivant j'aurai toujours pour technique d'étudier son milieu."

[8] My translation. See also Giard (1904).
"La signification attribuée généralement au mot "transformisme" est si étroite qu'il peut paraître audacieux et, en quelque sorte, paradoxal, de ranger Descartes parmi les fondateurs du transformisme. Cette manière d'agir se justifie cependant avec la plus grande facilité si l'on veut bien regarder le Transformisme, non point comme une simple explication de la production des races, des variétés et des espèces végétales ou animales, mais comme l'une des deux seules conceptions philosophiques par lesquelles on peut tenter d'expliquer l'existence de la matière, de l'univers et des êtres vivants."

> The meaning usually assigned to the term ''transformism'' is so narrow that it can seem audacious and, in some ways, paradoxical, to put Descartes among the founders of transformism. However, this way of proceeding is justified with the highest easiness if we accept to look at the Transformism, not only as a simple explanation of the genesis of races, varieties, and animal and plant species, but as one of the only two philosophical conceptions by which we can try to explain the existence of matter, of the universe and of living things.

Biologists, it was felt, only had to complete his explanation by extending it to the gradual formation of living things because of mechanical interactions. This was clearly the metaphysical objective of the first French neo-Lamarckians.

The Second Neo-Lamarckism: The Direct Influence of Bergson on French Biology

In his major book, Henri Bergson developed, in the first part, a critical review of the evolutionary explanations of the time. In this part of the text, he quoted directly some of the French neo-Lamarckians I have just presented (including Giard, Le Dantec, Perrier and Houssay) in order to give an exact representation of the biological knowledge in 1907. His main – and very famous – idea is that scientists (especially mechanicists) developed a very poor conception of the passing of time because they ''spatialized'' it. For Bergson, the real time, the duration, is a creative force, that is to say that novelties emerge in the universe. The evolution of living things, in this view, is seen as one of the most spectacular illustrations of this dynamic but unstructured creation process.

This book achieved a very large readership during nearly half a century in France and became a classic (Azouvi, 2007). Some deplored its views and influence (for instance Jacques Monod (Monod, 1970, p. 44)), but many others acclaimed it. It was precisely during the decade that followed the publication of Bergson's book that Albert Vandel and Pierre-Paul Grassé were trained in biology. During the late 1910s, they were confronted by some of the last representatives of the first wave of neo-Lamarckism (like Rabaud and Le Dantec, at least for Vandel – Le Dantec died at the age of 48 in 1917). This older, mechanical conception of life appeared then to be a very simplistic and dated one in comparison with some of the recent developments in embryology and physiology. For Grassé, Le Dantec's ''scientism was dead; [and] nobody planned to wake it up'' (Grassé, 1958a, p. 31).

According to these biologists, to understand the entire evolutionary process only as the result of the action of environment on living things was really a too simplistic explanation. That is why the same kinds of reproach were directed at both neo-Lamarckians (i.e. their predecessors), and Darwinians, like Julian Huxley, G.G. Simpson or furthermore Ernst Mayr[9] (Vandel, 1949, p. 120):

> [They] see organism only as a passive object modelled from the outside. However, while Darwinians put forward natural selection as the directive force for the adaptive transformations, neo-Lamarckians [French ones] attribute to external factors the decisive action. The organism would be modelled by the milieu, as the rock is sculpted by bad weather.

These too mechanical and too simplistic conceptions could not explain the progressive evolution, which led to *Homo sapiens* and his very special abilities. Evolution must be driven from the inside, because of vital properties. To this point, Bergson became the main inspiration for these neo-Lamarckians. His conception of duration as a creative process in life history was directly and explicitly taken up by Albert Vandel. In his main book on evolution, *L'Homme et l'Evolution* (1949), Vandel quoted Bergson on many occasions, and showed a profound respect to his philosophy of transformation (he called it a "masterly" development). According to Vandel, evolution is a *creative* and progressive process because it transcends the classical and mechanical phenomena of the material. Materialistic scientists are wrong because they do not consider life in its complete reality, but only in its physical implications. Evolution as an active phenomenon shows the development of the spirit through geological time, in vertebrates lines, but also in invertebrates lines (with the cephalopoda for example). This spiritual progression is the direct consequence of a kind of "effort" (Bergson's "élan vital" is not very far away from this formulation). In addition, in order to understand it, the classical analytical intelligence was deemed irrelevant. People must accept that only individual and personal *intuition* can offer a complete understanding of life (Vandel, 1953, pp. 45–46).

Aside to the direct influence of Bergson, Vandel also mentioned in many occasions the similarity between his conception of the general

[9] My translation.
"[Ils] ne voient dans l'organisme qu'un objet passif modelé de l'extérieur. Mais, tandis que les darwiniens invoquent la sélection naturelle en tant qu'agent directeur des transformations adaptatives, les néo-lamarckiens attribuent aux facteurs externes, l'action décisive. L'organisme serait modelé par le milieu, comme le rocher est sculpté par les intempéries."

transformation of life and the one defended by Teilhard de Chardin (Vandel, 1949, pp. 190–191). Vandel met Teilhard in Paris during the early 1920s, when they both prepared their Ph.D. (in Marcellin Boule's laboratory for Teilhard). After this first period, they continued to see each other even if the numerous travels of Teilhard made this relation very occasional. In 1957, he recognized the profound mark that Teilhard's synthesis on evolution produced on his own thought (Vandel, 1958, p. 48). Both of them placed *Homo sapiens* at the very apex of the phylogenetic tree, and therefore insisted that only this species could now be able to continue a progressive evolution, by improving its spiritual abilities. The next level of complexity was not seen as an organic one, but as a spiritual one.

For Grassé, the influence of Bergson and the similarities with Teilhard are not as transparent, but remain undisputable. He was also used to presenting evolution as a complication, which led to the development of the spirit. This progressive development shows creativity and finality, characteristics that cannot be explained solely by mechanical assumptions. Unlike Vandel, Grassé never quoted directly Bergson or Teilhard, and he even tried to minimize the role of these philosophers in the ideas developed by his colleague (Grassé, 1982, p. 22). The cover of his main book on evolution (*L'Evolution du vivant*, 1973), however, presents parallel lines, which start at an alpha point and end at an omega one. An illustration that is even more explicit than a quotation! Inside the book itself, the reader can find many implicit references to Bergson's creative evolution, references that led Ernest Boesiger to write and regret in 1974 that Bergson's influence was still strong in France at this moment (Boesiger, 1998, p. 314).

However as he wrote his main book on evolution only at the beginning of the 1970s, Grassé, unlike Vandel, tried to make clear in his general explanation that he knew molecular conceptions about life processes and heredity (Grassé, 1973, pp. 305–393). The Nobel Prize obtained in 1965 by François Jacob, André Lwoff and Jacques Monod forced those French zoologists, who had been reluctant to accept the importance of molecular biology, to take this new conception of life into account. This unsound synthesis makes his ideas very confused and quite difficult to understand for the present historian. Grassé seemed to believe that the evolutionary progress needed the creation of completely new genes, but the way these creations occurred remained unexplained and looked like a kind of miracle… Yet, essentially, his conceptions were very close to Vandel's and allowed him to re-introduce theological considerations in biology, as he did not hesitate to write that "God is the biggest discovery done by Humanity" (Grassé, no date, Archives de l'Académie des sciences).

This epistemological point makes their neo-Lamarckism very similar to the American version, which had been developed during the period 1860–1900 by paleontologists like Edward D. Cope (1840–1897) and Alpheus Hyatt (1838–1902) (Pfeifer, 1965; see also Gould, 1977; Bowler, 1992). It is notable that both Vandel and Grassé showed real respect for these naturalists (unlike Le Dantec for instance) and agreed with their progressive and orderly conception of evolutionary transformation (Vandel, 1949, p. 50). In a sense, Bergson led them to re-invent essentially the same transformism, albeit with a lapse of more than half a century. The major difference between their conception and the one supported by the American school was the importance of the recapitulation theory. The American paleontologists grew out of a prior concern with the embryological analogy, as Gould emphasized (Gould, 1977), and therefore the law of recapitulation was seen as a kind of internal and active motor in evolution. For Vandel and Grassé, the internal force was not so clearly identified, as we see. However, despite this theoretical difference, these transformisms agreed on a fundamental point: the progressive course of evolution must be understood as a proof of the existence of a Creator (Cope, 1887). According to Bowler and Pfeifer (Bowler, 1992, pp. 120–123; Pfeifer, 1965, p. 161), Cope and Hyatt developed Agassiz's idealist vision of natural order, which gave way to an orthogenic and vitalist form of Lamarckism. Such a conception authorized them to re-introduce theological considerations in science, exactly in the same way Vandel and Grassé did more than 50 years later. These metaphysical considerations could seem to be very far away from what is supposed to be a modern scientific knowledge about natural processes. To conclude this part, it is yet interesting to observe that they were surprisingly quite close – at least about the progressive trends of evolution – to these supported by some of the main architects of the synthesis, like Julian Huxley or Theodozius Dobzhansky.

It is a fact that Grassé used his personal situation in French science to prevent the development of the evolutionary synthesis in France. His 1973 book was for the essential an attempt to show that the problem of the mechanisms of life transformation was not solved yet, whatever the neo-Darwinians could say. The importance of this book was clearly recognized, as it was translated in English in 1977 (*Evolution of Living Organisms*). Reading the French version, one of the most important builders of the synthesis, Theodosius Dobzhansky, decided to produce a critical review of Grassé's arguments. In 1974, he came to Paris to give a lecture at the Collège de France and, with the collaboration of his friend

Ernest Boesiger, started to write a manuscript to give the reader a basis for a critical evaluation of Grassé's work. The book was finally published in 1983 (*Human culture: a moment in evolution*), after the deaths of both Dobzhansky and Boesiger (1975), thanks to the editing work of Bruce Wallace. In many occasions, the authors developed their opposition to Grassé's views. Concerning the direction of evolution and the sufficiency of natural selection, they wrote (Dobzhansky and Boeisger, 1983, p. 74):

> A philosopher or theologian has a right to consider the evolutionary line of man a privileged one: it is the most meaningful one for us humans (Theilhard de Chardin, 1955, 1959). Yet a philosopher as well as a biologist must recognize that, until the emergence of superorganic culture, the fundamental causes that operated in human ancestry were the same as those of other evolutionary lines. Contrary to the assertions of some biologists (such as Grassé, 1973, 1977), biological evolution does not occur according to any preconceived plan and has no direction other than that provided by the perpetuation of the species. The high frequency of extinction disclosed by the paleontological record shows that even this one "direction" is by no means always maintained. This is precisely what one might expect, because the principal guiding agency of evolution – natural selection – has no prevision of the future.

The interesting point is that the metaphysical positioning of Dobzhansky was obviously not as simple as this quotation could suggest. In a comprehensive work, Richard Delisle has recently shown that the metaphysical inclinations of the neo-Darwinians who were implied in the construction of the evolutionary synthesis were not identical, and furthermore, at least for some of them, not derived from the classical terms of the scientific theory (Delisle, 2009). This demonstration was evident for both Julian Huxley and Theodosius Dobzhansky, who believed in a general and progressive transformation of the universe, the biological evolution being only a part of this global process. Moreover, Dobzhansky often insisted that "the ascertainment of the fact of directedness of the general evolution is not tantamount to its explanation. The fact of directedness had been discovered, it would be seem, prematurely, before the causes that bring evolution about were even begun to be deciphered" (Dobzhansky, 1974, p. 312). He was also very interested in Theilhard's philosophy of evolution, even in its theological involvements (Delisle, 2009, pp. 138–139).

Hence, it seems that beyond a complete disagreement about the evolutionary mechanisms, some of the most famous neo-Darwinians developed a metaphysics of transformation pretty close to Vandel's and Grassé's, at least about the question of progress through geological times. Grassé himself was very pleased to underline this point, because for him, this convergence was a proof of the insufficiency of natural selection to explain the entire directed macroevolution[10] (Grassé, 1950, p. 203):

> I have to recall that for some, as it results from the declarations made right here, orthogenesis is only a fancy of the mind. Without being so attached to the term itself, I'm one of them who consider that evolution takes place according to determined directions, imposing to the phylum its main characteristics, and on this point, I have the feeling to be in agreement with many orthodox neo-Darwinians. Orthogenesis thus understood, merges at least partly with the evolutionary trends to which Julian Huxley dedicates the last chapter of his book [*Evolution, The Modern Synthesis*, 1942].

This unexpected convergence emphasizes the complexity of the links between philosophical beliefs and scientific knowledge in the field of evolutionary theory. For Delisle, the diversity of the metaphysical positions of the neo-Darwinians must be understood as a sign pointing out that the scientific explanation had not yet reached – during the 1940s and the 1950s – a complete positivity.

The Non-Necessity of Lamarck, the Construction of a Forerunner

Up to this point, it may have been noticed that the name of Lamarck himself has not even once be mentioned. If French neo-Lamarckisms had French roots, these have almost nothing to do with Lamarck's own biology. Lamarck must be seen as a dispensable figure for the course of this history. What would have been different if Lamarck had not existed? In reality, almost nothing would have changed except for the name denoting these transformisms. Of course, from Giard to Grassé, all of the

[10] My translation.
"Je rappellerai que pour certains, ainsi qu'il résulte de déclarations faites ici même, l'orthogenèse n'est qu'une vue de l'esprit. Sans m'attacher plus particulièrement au terme, je suis de ceux qui estiment que l'évolution se déroule selon des directions déterminées, imposant de la sorte au phylum ses principales caractéristiques, et sur ce point j'ai l'impression d'être en accord avec maints Néodarwiniens orthodoxes. L'orthogenèse ainsi comprise se confond, au moins en partie, avec ces tendances évolutives auxquelles Julian Huxley consacre le dernier chapitre de son livre."

biologists discussed here were quite familiar with at least a part of Lamarck's own thinking. However, they did not need him to develop their own conceptions. Their evolutionary views were clearly not elaborations of Lamarck's, but on some points, they seemed to be quite close to them: these biologists didn't continue a tradition that would have started with Lamarck, rather, they brought his contributions to light.

This retrospective construction occurred at first outside French science itself, within the American school. According to these scientists, they developed their ideas without being conscious disciples of Lamarck. Pfeifer explained that the first significant expression of this neo-Lamarckism occurred in 1866 at the Boston Society of Natural History, when Hyatt presented a text about the recapitulation theory (Pfeifer, 1965, p. 156). However, it was then necessary to wait until 1885 to see the introduction by Packard of the term ''neo-Lamarckianism'' in the literature. In 1901, in his famous biography of Lamarck, he added that the briefer form, ''neo-Lamarckism,'' was the more preferable (Packard, 1901, p. 396).

Quite the same historical sequence took place in France from the 1870s to the 1900s. At first, the experimental transformism was developed as a physiological programme derived from Bernard's principles. During the late 1880 s, French biologists started to insist on the similarities between their conceptions and the ones Lamarck defended at the very beginning of the century. They believed that their transformism were essentially the same as Lamarck's and then presented him as their forerunner (Perrier, 1893; Giard, 1904). This statement is obvious for the botanists: the reference to Lamarck in their texts appeared only in the last years of the 19th century, nearly 20 years after the beginning of their experimental work. In zoology, if Perrier had always been aware of the theory of Lamarck, Giard started to quote Lamarck mostly after his nomination in Paris, in 1888. Around 1900, all of these scientists referred to Lamarck, and presented themselves explicitly as Lamarckians or as neo-Lamarckians (Le Dantec preferred using the first term in order to emphasize the difference between their conception and the one supported by the American paleontologists). Some of them, like Perrier, started to re-write the story of Lamarck, in order to give him back his real place in the course of the history of science (Corsi, 1997).

The thing is quite more complicated for Vandel and Grassé. Both of them – especially Grassé – showed a great respect to Lamarck. Nevertheless, they considered him much more as an historical figure than as a scientific reference. They recognized in Lamarck the real founder of the evolutionary doctrine (Vandel, 1949, p. 47; Grassé, 1976, p. 792), even if

the mechanisms he proposed are not verified in modern knowledge. Therefore, they rarely presented themselves as Lamarckians or as neo-Lamarckians. However, contemporaries of these biologists – like Etienne Wolff (Wolff, 1986, p. 617) – always pointed out a kind of proximity between theirs conceptions and Lamarck's views. They also seemed to have a better understanding of Lamarck's transformism than most of the first Lamarckians. They usually didn't reduce it to the direct effect of environment on evolution because of the inheritance of acquired characters. Vandel, following Emile Guyénot (Guyénot, 1939), insisted on the distinction Lamarck opened between progressive evolution and adaptive evolution, distinction which was almost never understood by the first French neo-Lamarckians (except for Perrier). In addition, for both him and Lamarck, the most important process was clearly the complexifying one (Vandel, 1949, p. 47). Grassé, as he had to comment on the work of his friend and colleague when Vandel was elected in the National Academy of Science (1956), noticed that he modernized some of the conceptions of Lamarck himself about adaptation. Adaptation was not a passive mechanism, like early Lamarckians or present-day Darwinians believed, but on the contrary, had to be understood as an active reaction of the living, like Vandel contributed to demonstrate with his work on isopods (Grassé, 1958a, p. 35).

To appreciate the reconstructing process of Lamarck's figure that occurred successively around 1900 and afterwards around 1950, it is interesting to concentrate on the way these Lamarckians described and understood Lamarck's attitude about God. For the first ones, Lamarck was more or less an atheist – at least a "laic" figure, according to Costantin (Costantin, 1930, p. 10) – and it was only to escape from censorship that he occasionally introduced the name of the Creator in his writings. Marcel Landrieu, who was first trained in biology under the supervision of Alfred Giard, spent many years to elaborate a complete biography of Lamarck. In 1909, he finally published an extensive book on this subject, which was dedicated to Giard. At the end of his comprehensive study, after having emphasized the mechanical aspects of Lamarck's biology, Landrieu examined the "metaphysical preoccupations" of the naturalist. According to him, the atheism of Lamarck was quite obvious[11] (Landrieu, 1909, p. 381):

[11] My translation.
"C'est à cette conception d'une divinité sans action sur le monde actuel et par conséquent inconnaissable pour l'homme, que Lamarck semble s'être rallié pour détourner de lui les soupçons d'athéisme : en effet, malgré l'évidence de sa conception mécanique du monde, il fait sans cesse appel à l'action d'un être tout-puissant, dont il borne toutefois le rôle à n'avoir été qu'un premier moteur de la nature."

> It is to this conception of a divinity without action on the present world, and hence unknowable for men, that Lamarck seems to be rallied in order to divert from him suspicions of atheism: indeed, despite of the obviousness of his mechanical conception of the world, he introduced in many occasions the action of an all-mighty being, whose role, however, he restricts as only a first motor of nature.

As these first Lamarckians were mechanicists and for most of them atheists – Lanessan, Giard and after him Le Dantec claimed this point explicitly (see for example Le Dantec, 1906) – they depicted a Lamarck who must correspond to their own beliefs. Of course, when the second Lamarckians studied Lamarck's metaphysics, they didn't find the same forerunner. In 1979, Grassé took part in a meeting devoted to Lamarck and chose to remark on Lamarck's beliefs about God. In complete opposition to Landrieu – to whom he referred on some occasions – he tried to represent Lamarck as a real and genuine believer. By doing this, he revealed more about himself than about Lamarck, and when he concluded by writing that "creation and evolution are not contradictory process; the second continues the first" (Grassé, 1981, p. 210), he did reaffirm *his personal* conceptions, which linked science and theology, not Lamarck's.

Hence, for material scientists, Lamarck was obviously a materialist, and for spiritual ones, Lamarck was of course a spiritualist. This major disagreement strengthens the idea that the figure of Lamarck was mostly a reconstruction for both the first and the second neo-Lamarckians. Historically speaking, there were no necessary links between Lamarck and these Lamarckians.

Nevertheless, even from the point of view of the structure of the explanation, these two neo-Lamarckisms were quite different from Lamarck's. The first one was only focused on adaptation, and therefore had almost nothing to say about the progressive evolution (except for Perrier, once again (Loison, 2009)), which was the main problem of Lamarck (Burkhardt, 1977; Corsi, 1988). The second seemed to be much closer to Lamarck's views, because it also presented a two-factor conception, which was first an explanation of such progress. In complete opposition to Lamarck, however, Grassé and Vandel proposed a vitalist motor for this progressive evolution. Lamarck himself was an intransigent materialist, and his solution to the problem of organic complication was a very different one (Lamarck, 1809, pp. 91–112).

Therefore, for both historical and epistemological reasons it would be more correct to designate these transformisms by some name other

than "neo-Lamarckism." However, history has decided this matter for us, and it remains convenient to use the term (neo)-Lamarckism, if we can do so without being misled about the actual history of the ideas that it denotes.

Conclusion

French biology experienced at least two main successive forms of neo-Lamarckian thinking. The first one (1879–1931) was a mechanical and adaptive conception of life, and it was so because of Bernardian and Cartesian influences. The second one (1931–1985) was a vitalist and structuralist theory, directly derived from Bergson's philosophy of time. In their own way, these two opposite transformisms illustrate a deep and old dichotomy within French thought, which can be found in science (mechanism versus vitalism) and in philosophy (concept versus subject).

Yet, during this long history, one point does strongly unify these two very different neo-Lamrckisms: both of them were more critical conceptions than real scientific theories. This statement does not mean that they were false, according to present-day scientific knowledge (even if they were), but underlines that they did not propose real detailed explanations of the phenomena these transformisms postulated (adaptation by inheritance of acquired characters and afterwards progressive orthogenesis). Because of a lack of theoretical working out, both of them did not succeed to embody their metaphysical inclinations. These inclinations allowed them to be critical against successively the germ plasm theory (1880–1900), the mutation theory and mendelian genetics (1900–1910), chromosomal genetics (1910–1930), and at last the modern synthesis (1930–1980). On the contrary, these inclinations did not allow them to construct real scientific models of life transformations or of inheritance mechanisms, and subsequently, to perform experimental research (except, partly, for the beginning of the experimental transformism (1880–1900)).

These transformisms were more philosophical points of view focused on the evolutionary phenomenon than scientific theories guiding research programmes. Their philosophical roots were indeed much more than just a metaphysical background on which scientific ideas could be developed: they were rather the entire evolutionary thought in and of itself. That is why these lamarckisms had to vanish progressively during the course of the history of *science*.

Acknowledgements

I would like to thank Adam Wilkins for his attentive reading of this text. The numerous corrections he proposed were invaluable. I'm also very grateful to the reviewers of the first version of this article, who proposed very interesting critics in order to improve it.

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