

What history tells us XXII. The French neo-Lamarckians

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1. Introduction

Between 1870 and 1940, many of the most influential French biologists were neo-Lamarckian. They rejected the theoretical and experimental arguments of August Weismann that showed the impossibility of the inheritance of acquired characters. Adaptation was the result of a direct physico-chemical action of the environment on the organisms and their protoplasm, and the transmission of these modifications to the offspring. Neo-Lamarckians had the ambition to unravel the mechanisms by which the environment modified organisms, by studying such transformations in the laboratory. They called this new approach to evolutionary phenomena "experimental transformism". Neo-Lamarckians dreamt of doing for evolution what Claude Bernard and other physiologists had accomplished in explaining the functions of organisms.

Neo-Lamarckism was a complete failure. Experimental evolution yielded complex and conflicting results, and no experimental proof in favour of the inheritance of acquired characters was ever produced. Neo-Lamarckians were unable to face the difficulties and to develop new research programmes. Neo-Lamarckism delayed the development of genetics in France (Burian *et al.* 1988; Burian and Gayon 1999), and the reception of Darwinism. A positive side effect of this domination of neo-Lamarckism was seen in the programmes adopted by the French eugenic movement, which was as active in France as in other European countries (Schneider 1990). Adolphe Pinard, a doctor, at the head of the French Eugenic Society, was responsible for the development, during the first half of the 20th century, of care programmes for pregnant mothers and children: a better

environment during the early years of development was able to transform human beings.

Few studies have been devoted to this movement (Bowler 1992; Persell 1999). The recent publication by Laurent Loison of a book in French on the neo-Lamarckian movement challenges most of the legends that surround it, and shows it in a much more interesting light (Loison 2010). The author does not deny that it was unsuccessful, but he shows that in its early phase it was a dynamic scientific movement, with a strong unity and good reasons to explore the action of the environment. Laurent Loison contrasts the French and other neo-Lamarckian movements that flourished at the same period, such as American neo-Lamarckism (Pfeiffer 1965), with which it is frequently confused. I will illustrate some of the characteristics of the French neo-Lamarckian movement, as well as the reasons for its failure, by focusing on one of its most prestigious advocates, Maurice Caullery.

2. The true face of French neo-Lamarckism

Laurent Loison clearly shows that French neo-Lamarckians were not a small group of isolated scientists who developed their theories in ignorance of what was happening in other countries. The first French neo-Lamarckians, such as Alfred Giard (Tétay 1972), were much closer to the scientists working in foreign countries such as Germany than their predecessors had been. In a French biological community still influenced by the fixism of Cuvier, they were the first to adopt an evolutionary vision of the organic world.

They were as convinced as the early Darwinians that adaptation was the motor of evolution. The reason was that their favoured objects of study were the phenomena

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of parasitism and symbiosis. In parasitism, adaptation can adopt extreme forms in which some of the organs of the parasite, which have become useless, fully disappear. This emphasis on these extreme cases of adaptation explains why French neo-Lamarckians did not believe that the selection of random variations proposed by the Darwinians was sufficient. They considered that the variations leading to these dramatic changes had to be guided and instructed by the new environment. For them, understanding of the origin and nature of variations did not oppose Darwinian theory; it complemented it.

French neo-Lamarckians were materialists and considered that the action of the environment on organisms was the result of natural physico-chemical mechanisms. In this respect, they differed from the American neo-Lamarckians, who emphasized the existence of evolutionary trends within organisms. These trends were seen as oriented towards a goal, complexification and progress, and for this reason were frequently interpreted in spiritualist terms. These two antagonistic explanations of evolution – by the existence of internal trends and the direct action of the environment – were both present in the writings of Lamarck (Corsi *et al.* 2006), and French and American neo-Lamarckians selected – and partially altered – only one of the mechanisms proposed by Lamarck, which they considered as the only one of value.

Early neo-Lamarckians considered the inheritance of acquired characters as something evident, which did not need to be demonstrated. Such an attitude was probably shared by most biologists at that time. Things changed with the progressive dissemination and acceptance of the results of August Weismann. The existence of the inheritance of acquired characters had now to be experimentally demonstrated, and mechanisms allowing it proposed. French neo-Lamarckians failed on both counts. Initially, the direct effect of the environment and the inheritance of acquired characters found apparently strong support in the work of microbiologists, in the way they succeeded in attenuating pathogenic microbes by different physico-chemical treatments to prepare vaccines. This explains why some of the early neo-Lamarckians, such as Félix Le Dantec, were students and collaborators of Pasteur. The experiments of Gaston Bonnier (Schwartz 1970) on plants also demonstrated their plasticity in response to changes in the environment. But neither type of study directly demonstrated the inheritance of acquired characters.

However, neo-Lamarckians were not wrong when they stressed that Darwinian theory said nothing about the origin and nature of variations. In fact, only in the second part of the 20th century was the origin of mutations fully understood. And the precise nature of variations had to wait until the last decades of the 20th century to be more than the simple

replacement of a base, and to include other events such as deletions and additions of bases, transpositions, duplications of genes and parts of the genomes, genome rearrangements and so on. Recently, by looking at the molecular and cellular mechanisms generating novelty, Marc Kirschner and John Gerhart had the same feeling as neo-Lamarckians: that they were complementing and completing Darwin's theory (Kirschner and Gerhart 2005).

3. Maurice Caullery, one of the last neo-Lamarckians

Both to illustrate the previous presentation of neo-Lamarckians and to show the deadends they entered, I will consider the work and ideas of one of the last neo-Lamarckians, Maurice Caullery. Professor of zoology at the Sorbonne, Caullery worked at the Ecole Normale Supérieure and at the Laboratoire des Êtres Organisés (Laboratory of Organized Beings), where he succeeded Alfred Giard, and occupied the highest positions in French biology and zoology. He spent many years in Germany, and was invited professor at Harvard. He insists in his autobiography on the excellent relations he had with the most famous American biologists and geneticists, including Thomas Morgan (Telkes 1993). He was one of the first in France to publish a small popular book on genetics (Caullery 1943).

He considered genetics as the true science of heredity, and its results as highly important. This did not prevent him from thinking that the study of mutations was insufficient to explain the phenomenon of evolution: Most mutations are deleterious, and in any case they cannot explain the extraordinary adaptations that can be seen. He also stated that simple mutations are also not sufficient to explain the formation of a new species and of the barriers in reproduction that accompany it. He thought that only the environment was capable of generating perfect adaptations by directly acting on organisms.

In 1931, he admitted that it was a long time since he, as a young scientist, had dreamt of easily complementing the theory of Darwin by a description of the mechanisms by which the environment modifies organisms (Caullery 1931). Evolutionary theory had entered a deep crisis, the solution of which he did not see in the near future. As nicely expressed by Caullery, it was as if physicists had described the electronic structure of the atom but not the structure of the nucleus. It had been convincingly demonstrated that the inheritance of acquired characters did not exist in the present living world, but Darwinian theory was unable to explain evolutionary facts. For Caullery, evolutionary steps did not correspond to mutations, but to a global reorganization of the genome which allowed its natural stability to be overcome. The trigger was in the action of the environment at the earliest and most important step in development, the egg stage. Evolution is behind us; special conditions that

permitted it in the past no longer exist in the present world. This explains why the inheritance of acquired characters cannot be experimentally observed in the laboratory.

The lack of experimental results on “transformation in the laboratory”, and the limits he saw in Darwinian theory, pushed Caullery to abandon the principle of actualism, the possibility of explaining historical facts by mechanisms still acting in the present world. The possibility in the future of describing these mechanisms no longer active in the present world was not obvious. Faced with experimental difficulties, neo-Lamarckians such as Caullery did not reconsider their theories but preferred to adopt a solution that put an end to the explanatory ambitions of science.

4. Some conclusions

For neo-Lamarckians, one of the main characteristics of organisms was plasticity. Organisms exhibited this plasticity in response to variations in the environment. Neo-Lamarckians never seriously addressed the contradiction between the existence of plasticity and the stable hereditary transmission of the modifications acquired through this plasticity.

The word “plasticity” is now fashionable again (West-Eberhard 2003). Epigenetic variations, frequently seen as an example of plasticity, are also considered in some cases to be transmissible to the offspring (Jablonka and Lamb 1999). Those supporting these views already faced the same difficulty as that faced by neo-Lamarckians.

As we showed previously, neo-Lamarckians were a dynamic group of researchers, but this initial drive vanished. No new programmes of research emerged when the first ones failed. Neo-Lamarckians repeated their criticisms of Darwinism without proposing any new model. Maybe the two explanatory models – neo-Darwinism and neo-Lamarckism – were too different to allow researchers to easily shift from one to the other. Maybe also the rigid and centralized French academic system was not favourable to such an “adaptation” of neo-Lamarckians.

The arguments of French neo-Lamarckians against Darwinism were not devoid of value, and the study of variation only recently found its place in evolutionary theory. The reasons neo-Lamarckians opposed Darwinism were not religious. Rather, they show how revolutionary, and therefore difficult to accept, the theory of Darwin was. In contrast, the inheritance of acquired characters was obvious and did not require any justification; the kind of evidence that the French philosopher of science Gaston Bachelard considered as one of the major obstacles to the progress of science (Bachelard 1938). The case of French

neo-Lamarckism shows that criticisms aimed at Darwinian theory must not be systematically categorized as religious and spiritualist. Such an attitude prevents free scientific debate and hamper us in our attempts to meet the challenges raised by the construction of an evolutionary theory.

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