of form is extended into the section that follows on developmental models with three chapters on developmental asymmetries, 3-D cell-based modeling, and neuronal growth and morphology. Van Pelt and Uyling's modeling of dendric trees resonates with earlier discussions of explorations of morphospace, and also bears on the selection of phylogenetic trees from a space of possibilities. Palsson also describes how cells can be modeled, but from a different perspective as he describes how simulation of cell interactions in space can be used to generate explanations of the complex forms of cellular interaction in slime mold colony formation and movement. Rasskin-Gutman, Miguez, and Izpisua-Belmonte are also interested in modeling at the cellular level to explain developmental asymmetries, but wish to integrate these cellular models with models of regulatory genetic networks. Because the integration of many different levels of biological organization is an important aspect of development, these authors describe the crucial task of articulating and integrating diverse forms of models for different levels of biological phenomena.

That models are necessarily idealized representations of complex realities is a persistent theme in this collection. Schank and Koehnle address the issue of idealization and model assessment explicitly in the next section on modeling behavior. While philosophers and biologists have been discussing standards for model and theory evaluation for years, Schank and Koehnle mov beyond the typical discussions of the value of generality versus precision to consider models as historical entities that can be represented in phylogenies or lineages. These model genealogies are powerful tools for representing and understanding the historical and conceptual relationships between models. The effect is to shift our focus from the assessment of an individual model to the process of assessing, revising, and learning a series of models.

Modeling Biology concludes with a section on modeling in evolution. As in earlier chapters, computational models of morphospace occupy a central place in these chapters. However, where human judgment intervened earlier to navigate the space of possibilities, here Niklas and the other contributors must integrate the effects of natural selection on the realization of natural forms. As Collins, Gilbert, Laubichler, and Müller point out in the chapter on models in Evo-Devo, adding an evolutionary perspective raises the challenge of not simply modeling evolution, but of integrating the many different biological processes that inform biological change over time. In terms of models, this translates into a challenge to create different model systems that can capture different aspects of biological integration and to then find ways to further model the interplay of the processes described in these model systems. In effect, the integration of genetic, developmental, and evolutionary processes will draw on the entire array of approaches and strategies for modeling described throughout this collection and as such is a fitting chapter to end of this collection.

Modeling Biology offers a compelling overview of the practice of modeling in contemporary biology, while advancing our analysis of the range of philosophical issues surrounding models and modeling in science.

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Laurent Loison, *Qu'est-ce que le néolamarckisme? Les biologistes français et la question de l'évolution des espèces* (with a foreword by Michel Morange), Paris: Vuibert, 2010, vi + 248 pp., illus., € 29,00.

The appearance of this book is particularly timely, given that the issue of epigenetics or "soft inheritance" has been raised again. The reader may be surprised to learn that French Neolamarckism between the 1870s and the 1930s (the main period under consideration

here) has little to do with Jean-Baptiste Lamarck himself, American Lamarckism, or even the inheritance of acquired characteristics (10-14, 149, 156). Through an analysis of the published work of key scholars like Gaston Bonnier (1853-1922), Maurice Caullery (1868-1958), Julien Costantin (1857-1936), Yves Delage (1854-1920), Alfred Giard (1846-1908), Félix Le Dantec (1869-1917), Edmond Perrier (1844-1921), and Étienne Rabaud (1868-1956), the author seeks to identify the theoretical corpus that united them. As such, the perspective of the book is more along the lines of an "internal history" (9). This perspective is a welcome one considering our current lack of understanding of the scientific aspects of French Neolamarckism and Lamarckism in general, and constitutes a departure from the all-too-common social and ideological approaches (i.e., Kammerer, Lysenkoism, etc.) used to investigate this multi-facetted movement. Whereas Lamarck (1744-1829) attempted to explain the process of evolution in terms of the action of two principles (an internal yet mechanistic drive toward complexification and an adaptive response to the conditions of the milieu), the French Neolarmarckians had entirely given up on this first principle by constructing a biology exclusively centered around the notion of life responding to the environment (adaptation). It is precisely this crucial choice which separates the French Neolamarckians from the American Lamarckians, for the latter opted for an internal drive towards complexification and directionality (orthogenesis), a gap reinforced by the materialistic bent of the French school (as opposed to the vitalistic one taken be the Americans). As far as the question of the inheritance of acquired characteristics is concerned, Loison rightly argues that this has never been a discriminating factor among the various brands of evolutionism, as can be seen in Darwin's own uncertainties about heredity. Although the French Neolamarckians needed the inheritance of acquired characteristics to be true in order to bolster their view of evolution (14-15), the fact remains that this mode of inheritance was usually merely taken for granted by them and was not the focus of sustained research efforts. The exception to this came in the 1880s and 1890s when some of these scholars, engaged in observations in nature and lab experiments, noticed that living forms were modified as the environment changed (chap. 1). Biologists of the time, however, following August Weismann's involvement in the debate, eventually recognized that empirical results available at that time did not allowed for a clear discrimination between hard and soft inheritance (158-159).

The question was gradually dropped by French Neolamarckians, who turned their attention to other aspects of their research programme. The most illuminating aspect of Loison's analysis, at least to me, concerns the exposition of these other aspects. These have been largely overlooked by a historiography (the "Darwin industry") devoted to thinking solely in terms of evolutionary mechanisms, and to distinguishing between bad and good evolutionists. The misunderstanding between Darwinians and French Neolamarckians was total, since they had directed themselves toward constructing two different kinds of biology. The Darwinians took variation as a *cause* or starting point for their reasoning, resulting in a "downstream" biology seeking concepts capable of explaining how variation could be directed to generate evolution. For their part, the French Neolamarckians saw variation as *effect*, turning their attention to a "upstream" biology in search of the ultimate (i.e., physico-chemical) cause of variation (chap. 2). One key initial opposition seems to have been responsible for determining all other aspects: the way the organism is conceived, *ontologically* speaking. Darwinians were prepared to recognize a *dualism of matter at the biological level*; that is, the stuff of heredity which is transmitted across generations was believed to be different from its carrier, being distinct from the rest of the organism which acted as vehicle. On their side, French Neolamarckians subscribed to a *monism of matter at the physico-chemical level*, reducing the biological organism to its protoplasm, which itself was reduced to its physico-chemical components through the colloid level (68-70, 140-142).

The implications of this fundamental opposition are far reaching. Darwinians, especially among their organismic proponents, were able to establish a sharp distinction between the biotic (organisms, populations) and the abiotic (the environment) worlds, thus elaborating a theoretical/conceptual apparatus which conceived the dynamics of evolution in terms of their encounters and tensions. By diluting the biotic world into an abiotic one, French Neolamarckians denied there was such a sharp distinction between "biological" organisms and their environment; on the contrary, they argued that a continuum existed between the physico-chemical components of the environment and the physico-chemical components housed within the internal milieu of the "biological" organism. On this view, evolutionary changes instituted through the inheritance of acquired characteristics were nothing more than the direct transmission of one physico-chemical change (the environment) to another physico-chemical reality (the organism). Was there really a need, then, for fancy theoretical and conceptual developments (such as those proposed by Darwinians) to explain what seems to be merely a natural, mechanistic, and deterministic process of induction going from the environment to the organism? It would appear that it is this fundamental *ontological* opposition between Darwinians and French Neolamarckians which transcends all the other aspects separating them, and which are presented in Laurent Loison's book. For instance, it seems only logical that the *epistemology* used by French Neolamarkians should be a reductionistic one (63), while Darwinians instead turned to holism (especially among organismic biologists). Furthermore, it is unsurprising that French Neolamarckians thought experimentation was perhaps the only *method* for acquiring good scientific knowledge in light of their physicalistic bent (110-111). This view, however, could not be accepted by Darwinians working in zoology, morphology, and paleontology, for example, where observation plays a fundamental role. These philosophical choices are echoed in the French Neolamarckians's *empirical* preferences for studying primitive and simple life forms closer to the physico-chemical world, in contrast with organismic Darwinians, who were more at home with complex and highly organized animals clearly distinguishable from the abiotic world (130).

Because Loison is studying what he considers a failure – the rise and fall of French Neolamarckism – it would have been profitable to make more explicit what is only implicit in his analysis: the notion of a degenerating research programme *à la* Imre Lakatos. Fortunately, Michel Morange's foreword to the volume has somewhat contributed to filling the void. What I question, above all, is the fate of this research programme as understood by Loison. After all, Lakatos himself recognized the possibility for a degenerating research programme to become once again progressive under certain circumstances. If French Neolamarckism proper is dead, is its spirit truly dead as well? Quite often we see in history of science old wine being put into a new bottle. It seems to me that, precisely because the inheritance of acquired characteristics was not so central to French Neolamarckism's research programme, several of its key components are still with us today. For instance, Loison argues that the rise of molecular biology in the 1950s was one of the two factors leading to a definitive refutation of French Neolamarckism, the other being the rise of the Synthetic Theory of Evolution (p. 206). Apparently, the author assumes that molecular biology constitutes a natural extension of Darwinism, but only at lower levels of matter, thus outcompeting French Neolamarckism in its own "physico-chemical" stronghold. This assumption, however, overlooks major debates that divided molecular and organismic biologists falling under the so-called "Darwinian umbrella," precisely over issues such as reductionism/holism, experimentation/observation, simple organisms/complex organisms, and so on. The situation today seems not to be very different, particularly when the implications of chaos theory and self-organizing principles are considered in the context of evolutionary biology. What, then, is the "essence" so-to-speak of French Neolamarckism? The historian of science Jacques Roger was certainly right

to insist on a physicalistic strand of biology which has prevailed since the 18th century, and of which molecular biology is a prominent part (see several of Roger's essays in *Pour une histoire des sciences à part entière*, 1995). Loison's important and very readable contribution puts in place one more piece of this complex picture of parallel and overlapping intellectual movements in Nineteenth- and Twentieth-century evolutionary biology.

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Snait Gissis and Eva Jablonka (eds), *Transformations of Lamarckism: From Subtle Fluids to Molecular Biology*, Cambridge, MA: MIT Press, 2011, 432 pp., 23 illus., $50.00 / £34.95.

The premise of *Transformations of Lamarckism* can be summarized succinctly. The discovery and recent progress in the elucidation of the mechanisms of epigenetic inheritance and plastic responses to environmental stimuli legitimizes the revival of a Lamarckian notion of "soft inheritance" which, although originally endorsed by Darwin, was subsequently dropped out of evolution by the architects of the Modern Synthesis. The forty-one essays in this book explore the history of Lamarckism, its fatal clash with Mendelian genetics, and the consequences of a revival of Lamarckian perspectives for our understanding of evolution and inheritance.

The book is organized roughly in chronological fashion. Part I covers the history of Lamarckian thinking, beginning with Lamarck himself and ending with Lysenko's controversial critique of genetics. One theme explored by several essays is the complex relationship between heredity and plasticity, and its implications for our understanding of adaptation and ultimately evolution. The recurrent argument associated with this theme is that Darwinism and Lamarckism coexisted for almost half a century and, therefore, there is nothing fundamentally contradictory between these two approaches to adaptation and evolution. The text is well balanced. While the subtleties and richness of some of the ideas put forward by proponents of Lamarckism are given the careful attention they deserve, theoretical inconsistencies and experimental difficulties which eventually contributed to the demise of Lamarckism are by no means ignored.

The book's second part covers the Modern Synthesis and the systematic purging of Lamarckian ideas. The main culprit responsible for this purging is Mendelian genetics or, to be more precise, the assumption that "the Mendelian gene is the sole hereditary factor" (105). Essays in this section explore the socio-political environment surrounding the "Lysenko scandal" and its unfortunate impact on the research of epigenetic inheritance, the emergence of developmental biology, as well as the theoretical and experimental findings (or lack thereof) that contributed to the rejection of Lamarckism. Again, it is interesting to note that Lamarckism was rejected not because it proved to be fundamentally incompatible with Darwinism, but rather because of a poor understanding of the scarce evidence for "soft inheritance" available at that time, combined with the fact that population genetics provided a theoretical framework showing that, in principle, evolution can proceed exclusively via small, undirected changes in multiple genes.

Part III covers recent discoveries demonstrating that some ideas of inheritance put forward by Lamarck have been wrongfully neglected. Several mechanisms of genome expression regulation are discussed, most notably inducible DNA expression, DNA methylation, histone acetylation, and inhibitory RNA systems. Stress-induced genetic variation, maternal inheritance, the endosymbiont origin of mitochondria/plastids, and genetic assimilation are also discussed. However, if the reader expects support for the view that Lamarck's theory