Journal of the History of Biology (2019) 52:161–194
https://doi.org/10.1007/s10739-018-9522-2

Between Social and Biological Heredity: Cope and Baldwin on Evolution, Inheritance, and Mind

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Abstract. In the years of the post-Darwinian debate, many American naturalists invoked the name of Lamarck to signal their belief in a purposive and anti-Darwinian view of evolution. Yet Weismann's theory of germ-plasm continuity undermined the shared tenet of the neo-Lamarckian theories as well as the idea of the interchangeability between biological and social heredity. Edward Drinker Cope, the leader of the so-called "American School," defended his neo-Lamarckian philosophy against every attempt to redefine the relationship between behavior, development, and heredity beyond the epigenetic model of inheritance. This paper explores Cope's late-career defense of neo-Lamarckism. Particular attention is dedicated to the debate he had with James Mark Baldwin before the publication of Baldwin's own "A New Factor in Evolution" (1896d). I argue that Cope's criticism was partly due to the fact that Baldwin's theory of social heredity threatened Cope's biologistic stance, as well as his attempt to preserve design in nature. This theoretical attitude had a remarkable impact on Baldwin's arguments for the theory of organic selection.

Keywords: Edward Drinker Cope, James Mark Baldwin, neo-Lamarckism, neo-Darwinism, Baldwin effect, Social heredity

Introduction

By 1876, the American entomologist Alpheus Packard recognized three main phases in nineteenth-century American biology. There was the epoch of systematic zoology during which research was "greatly accelerated by the influence of national and especially state surveys"

(Packard, 1876, p. 592). Almost simultaneously, there was an epoch of morphological and embryological zoology due in large part to Louis Agassiz's arrival in America in 1846. Finally, there was the epoch of evolution. Packard dated this last period from the publication of Darwin's *Origin of Species* (1859), and detected therein "an original and distinctively American school of evolutionists" (Packard, 1876, p. 597), the same school he would later term "neo-Lamarckianism."

Scholars have been arguing for decades about the historical and epistemological character of such a neo-Lamarckian movement. From the 1970s, historians have reassessed the influence of Jean-Baptiste de Lamarck on nineteenth-century evolutionary biology (Burkhardt, 1977; Barsanti, 1979; Corsi, 1983, 1988; Corsi et al., 2005; Gissis and Jablonka, 2011). Especially in the last few decades, the evo-devo studies and the advances in the understanding of epigenetic mechanisms (Pigliucci and Müller, 2010; Jablonka and Lamb, 2014) have revived historians' interest in Lamarck's legacy, thus helping to reshape the narratives of Lamarckism (Bowler, 2017, p. 214). It has been pointed out, for instance, how the work of Lamarck, far from being underestimated by his contemporaries, triggered an intense discussion in England, France, Germany, and Italy between the 1820s and the 1850s (Corsi, 1978, 1988, 2011). Scholars have increasingly analyzed the reinterpretations and misconceptions of Lamarck's theory which have circulated since the mid-nineteenth century. Part of this historical survey has been carried out through the study of the so-called "neo-Lamarckian" movements.[1]

Though neo-Lamarckian claims appeared ubiquitously in late-nineteenth century evolutionary debates, American neo-Lamarckism has been generally considered a rather cohesive as well as peculiar movement (La Vergata, 1995; Bowler, 1983; Gissis, 2011). In 1965, Edward J. Pfeifer stated that American neo-Lamarckians, unlike British anti-Darwinians, did construct a real rival to Darwinian theory. They even provided, in the words of Pfeifer, "a system more complete than Darwin's" inasmuch as they adduced solutions to the main problems for a Darwinian standpoint (1965, pp. 158–160). For the American neo-Lamarckians, the morphogenetic power of environment and bodily actions formed parts of an explanatory model that overcame Darwin's main theoretical problems: the randomness of individual variations and the long times required for their accumulation through natural selection. According to such scholars as Edward Drinker Cope, Alpheus Hyatt,

[1] See in particular the works by Pfeifer (1965, 1988), Stocking (1962), Roger et al. (1979), Moore (1979), Bowler (1977, 1983, 1985), Gould (1977, 1981), Greenfield (1986), and Loison (2012).

and Alpheus Packard, Darwin's "bigger idea" that variations are blind with respect to the future shape of organisms could not give any account of the origin of evolutionary novelties (Johnson, 2015, p. xii). Macroevolution showed law-like patterns that could not be explained through the Darwinian theory of natural selection operating on random variations. Even less, natural selection offered explanation as to the origin of those overspecialized structures which had driven many taxa to extinction.

The idea that biological changes were due to individual efforts appeared to be a more appropriate view in light of the positivist conceptions of causal determinism. American neo-Lamarckians assumed that post-embryonic variations acquired through individual activity could be inherited, and then theorized their accumulation as terminal additions and subtractions in ontogeny (Gould, 1977). This assumption entailed a linear causal relationship between individual variability, organisms' structures, and phyletic trends that complied with a law-like view of nature. Furthermore, it seemed to provide an explanation for overspecialization. Even when acquired as adaptations to external stimuli, habits through use-inheritance might drive new structures "beyond the limit of utility" (Bowler, 1983, p. 119), thus producing overspecialized groups.

Yet several historians disagree with the theoretical consistency of the so-called "American school," a consequence of broad difficulty in deciphering a clear coordination of efforts among American neo-Lamarckians (Greenfield, 1986; Numbers, 1998). Still more recently, neo-Lamarckism has been considered a kind of indefinable historiographical label, to the extent that it meant so many different things to so many different naturalists (Jablonka and Lamb, 2014, p. 21). Moreover, it is difficult to evaluate the deployments of Lamarck (Gissis, 2011, p. 25) without considering the broader deployment of factors, mechanisms and evolutionary stances which, more or less properly, have been called "Lamarckian" over time. Generations of biologists assumed the law of the inheritance of acquired characteristics was a synonym of Lamarckism, even though Lamarck's original principle of the transmission of fluid distribution patterns was based on a commonsensical view shared by many eighteenth-century naturalists – thus, not especially or distinctively characteristic of Lamarck's views at all (Barsanti, 2005; Burkhardt, 2013; Corsi, 1988, 2011, 2012; Corsi et al., 2005).[2] No less

[2] In this regard, Richard Burkhardt stated: "Lamarck has come to be remembered primarily for the idea of the inheritance of acquired characters, an idea in which he invested no intellectual energy and for which he never expected or cared to be remembered" (2013, p. 804).

attention has been given to the fact that many naturalists invoked the name of Lamarck to signal their belief in a purposive view of evolution based on psychological principles which went far beyond Lamarck's conception of the relationship between *physique* and *moral* (Boller, 1969; Bowler, 1983, 1985; Moore, 1979). Over two centuries, the use-inheritance theory played an essential role in a large spectrum of doctrines that regarded evolution as the outcome of organisms' conscious response to environmental stress. As a variety of neo-Lamarckism, which attributed sensitive qualities to all animals regardless of their nervous organization, such theories have often been labeled "psycho-Lamarckian" by historians (Bowler, 1983; Gliboff, 2011). Edward Drinker Cope, the most fervent advocate of neo-Lamarckism in America, represented the lead proponent of this view, accompanied by European biologists August Pauly and Raoul Heinrich Francé.

Through the appropriations of Lamarck into various theoretical and historical frameworks, "neo-Lamarckism" became as flexible as the organism imagined by Lamarck (La Vergata, 1995), spreading rapidly as a self-definitory label among many American scientists. Though opinions varied greatly among American neo-Lamarckians (Numbers, 1998, p. 34), the question arises as to what led them to place their theories under the same label. In this regard, this paper aims to reconsider the parabola of American neo-Lamarckism in light of the multiple-level challenge brought about by the neo-Darwinian model on inheritance. I argue that the attack against epigenetic inheritance undermined the shared tenet of the neo-Lamarckian theories as well as the idea of the interchangeability between biological and social heredity, thus threatening a broader deterministic view of biological and social progress. This will help us to highlight how the polarization between neo-Darwinian and neo-Lamarckian arguments was fostered by extra-scientific issues, and how that social transmission came to represent the main bone of contention between the parties.

The first section of the paper will reconsider the "Weismann effect" (Gissis, 2011, p. 29) regarding its propulsive impact on the works of the American neo-Lamarckians, notwithstanding the irreducible diversity of positions that featured the movement. The second section will focus on the way that Edward Drinker Cope, as the leader of the American school, defended the neo-Lamarckian interpretation of biological inheritance from any extension or revison brought about by the Weismannian turn. Particular attention is devoted to Cope's epistolary confrontation with George Romanes and Henry Fairfield Osborn. In the final section, I argue that Cope's late-career defense of epigenetic

inheritance played an indirect, though essential, role in the theorization of the "Baldwin effect." By analyzing the Cope-Baldwin debate that took place between 1895 and 1896,[3] I will show that part of James Mark Baldwin's arguments for the theory organic selection were indeed directed against Cope's assumption that mental habits were as inheritable as physical traits.

Behind the Label

Packard's first definition of neo-Lamarckism appeared in 1885 in the *Standard Natural History*. Despite his somewhat grandiloquent tone, he summarized very clearly the reasons that had moved a new generation of American naturalists toward a non-Darwinian explanation of evolution, namely the epistemological frailty of the theory of natural selection, especially when applied to macroevolution. Natural selection, Packard stated, was more an idea than a vera causa:

> [Natural selection] begins with the assumption of a tendency to variation, and presupposes a world already tenanted by vast numbers of animals, among which a struggle for existence was going on, and the few were victorious over the many. But the entire inadequacy of Darwinism to account for a primitive origin of life forms, for the original diversity in the different branches of tree of life forms, the interdependence of the creation of ancient faunas and floras on geological revolutions, and consequent side changes in the environment of organisms, has convinced us that Darwinism is but one of a number of factors of a true evolution theory; that it comes in play only as the last term of a series of evolutionary agencies or causes; and that it rather accounts, as first suggested by the Duke of Argyll, for the preservation of forms than for their origination. We may, in fact, compare Darwinism to the apex of a pyramid, the larger mass of the pyramid representing the complex of theories to account for the world of life as it has been and now is. In other words, we believe in a modified and greatly extended Lamarckianism, or what may be called neo-Lamarckianism. (Packard, 1885, pp. liii–liv).

As Packard had already recognized in 1876, the leading figures of this movement were the famous paleontologists Edward Drinker Cope

[3] Although not thoroughly analyzed by historians, parts of the debate have been discussed by Richards (1987, pp. 490–491), Griffiths (2003, p. 213), and Hoffmeyer and Kull (2003, p. 254).

(1840–1896) and Alpheus Hyatt (1838–1902). Ignorance of the laws of variation and of inheritance, together with the necessity of giving an account of the seeming linearity displayed by fossils, led these scientists toward anti-Darwinian theoretical assumptions. Instead of assuming Darwin's main mechanism of natural selection as the primary factor of evolution, Cope and Hyatt based their theories on embryological and post-embryonic changes transmissible to offspring (Packard, 1876, p. 597). Such an approach resulted from the intersection of two sets of empirical data: embryonic paths and fossil series. By co-opting Louis Agassiz's law of "threefold parallelism," Cope and Hyatt tied together ontogenetic and fossil trends through the biogenetic law, and thus explained them as organisms' adaptive responses to environmental changes. As widely discussed by Stephen Jay Gould (1977, 1981, 2002), this view led Cope and Hyatt to reconsider the timing of individual development. Acquired characters indeed had to alter the speed of development in order to leave time for their addition as terminal stages. Likewise, deletions made it necessary to assume forms of ontogenetic retardation and shortening.

Historians have widely emphasized how such an intersection between morphological studies and adaptationism did not feature the whole American neo-Lamarckian movement. According to Peter Bowler (1983, p. 118), there were American neo-Lamarckians who did not belong to what Packard recognized as the American School. Many self-proclaimed American neo-Lamarckians were indeed of the more conventional variety, while others showed a strong belief in what has later been called "environmentalism" (Bowler, 1983, 1985). Even Cope and Hyatt show important points of divergence. Unlike Cope, Hyatt staunchly supported a degenerationist view of orthogenesis which, in his opinion, was preeminently due to a universal acceleration toward senile stages (Gould, 1977, p. 92). Moreover, Hyatt condemned Cope's interpretation of the heritable adaptive reactions in terms of psychological phenomena. According to Hyatt, the attribution of sensitive qualities to invertebrates – or even worse, to amoebas – represented an undisguised form of anthropomorphism (1884, p. 125).

Though American neo-Lamarckians may not have been driven by a unity of purpose toward a single research program, they did not hesitate to place their own theories under the same general label. The reasons behind such a paradox can likely be ascribed to the changing structure of the late nineteenth-evolutionary debate (Churchill, 1968). For several years, Cope, Hyatt, and Packard did not define themselves as Lamarckians. Cope even admitted to having learned about Lamarck mainly

through secondary literature.[4] It is at least curious that, during the last decade of the nineteenth century, some of these authors invested time and money in the magnification of the great French naturalist by publishing translations as well as volumes in his honor (Pfeifer, 1965, p. 162).[5] On closer inspection, the self-attribution of the label "neo-Lamarckism" seemed to spread during the 1880s as a general, though not entirely unambiguous, answer to Weismann's writings on the separation of germplasm from the somatoplasm, which had a remarkable impact in America. "Abstracts and reviews of them" Lester Ward pointed out in 1891, "occurred in *Nature* and the English magazines," and the controversy involved "most eminent biologists of Europe and America" (1891, p. 33). It was Weismann's experimental methodology that fueled much of the criticism. Since early 1885, Weismann had argued that the germplasm remained "undisturbed by the activity of development" as well as "isolated from the indirect environmental influences" (Churchill, 2015, p. 312). In 1888, the German cytologist famously declared that somatic modifications do not produce changes in the germ line after he experimentally demonstrated that the offspring of mice whose tails had been removed continued to be born with tails. Reacting to such conclusions, many naturalists attributed fallacies and misconceptions to Weismann's methodology, starting from the fact that he had tried to disprove the inheritance of acquired characteristics through the study of

[4] In "The Method of Creation of Organic Forms," Cope admitted: "The writer has never read Lamarck in French, nor seen a statement of his theory in English, except the very slight notices in the *Origin of Species* and Chambers's Encyclopedia, the latter subsequent to the first reading of this paper" (1871b, p. 262). According to Packard, Hyatt did not read Lamarck during his formative years either (1901, p. 386). As Bowler suggested, Packard was likely the only American neo-Lamarckian to have had a prior interest in Lamarck's writings (1983, p. 134). This seems by no means implausible judging by the references to Lamarck that appear in Packard's early diary. In the note dated January 20, 1855, he wrote: "Got the key to the Peucinian Library…got out one vol. *Naturalist's Library*, containing the life of Lamarck, and one vol. of Journal of Science" (Cockerell 1920, 186). However, Bowler maintains that "like Cope and Hyatt, Packard was attracted first to the concept of evolution by addition to growth, and only later saw the inheritance of acquired characters as an explanation of the effect" (1983, p. 134).

[5] With Cope as editor-in-chief, *The American Naturalist* published one of the first English translations of Lamarck's writings. The translation was limited to the seventh chapter of the *Philosophie Zoologique* and appeared between November and December 1888 (Vol. 22, No. 263; Vol. 22, No. 264). In 1901, Packard republished other paragraphs and chapters of Lamarck's works in the volume *Lamarck, the Founder of Evolution*. As he wrote in the preface, it was only "within the past fifty years that the scientific world and the general public have become familiar with the name of Lamarck and of Lamarckism" (Packard 1901, p. v).

accidental modifications. ''Pure Lamarckism,'' Ward emphasized in his famous speech at the Washington Biological Society on January 24, 1891, ''has nothing whatever to do with such a question'' insofar as mutilations ''are not the object of creature's efforts, and are not acquired by any functional or habitual activities'' (1891, p. 23).

Despite his attempt to develop an alternative solution to the neo-Lamarckian challenge through his theory of germinal selection (Weissman, 2011), Weismann ended up being regarded as the leader of the most radical and uncompromising form of selectionism. Reactions against the *Allmacht* of selection formed a heterogeneous international front. The works of George Romanes and Herbert Spencer fostered much of the debate in the Anglo-Saxon context. According to Romanes, a pupil of Charles Darwin's, Weismann had made natural selection a totipotent factor, thus laying the foundation for ''neo-Darwinism'' or ''ultra-Darwinism'' (1888). Furthermore, the work of Weismann had led to confusion among biologists, since many of them started to identify the pluralist view of Darwin with the ultra-Darwinian one (Romanes, 1895, p. 12). In his attempt to preserve a pluralist approach to evolutionary change, Romanes opposed the dogmatic exclusion of any possible interruption of the germplasm continuity. At the same time, he expressed perplexity about neo-Lamarckism. Cope and Hyatt's explanations had epistemological weaknesses, for the facts they adduced were ''not crucial as test-cases between the rival theories nearly all of them, in fact, being equally susceptible of explanation by either'' (Romanes, 1895, p. 63).

Spencer, who had advocated an evolutionary philosophy encompassing the use-inheritance theory since the publication of ''The Development Hypothesis'' (1851), came out against Weismannism in the well-known series of articles published in the *Contemporary Review* (1893a, b, c, 1894, 1895). Here the British philosopher rehashed a number of arguments he had already used in *The Principles of Biology* (1864), highlighting how natural selection could not account for the origin of incipient structures and complex bodily structures. In higher organisms, Spencer maintained, the inheritance of acquired characters was ''an important, if not the chief, cause of evolution'' (1893a, p. 456). Such public defense of the use-inheritance theory allowed Spencer to be perceived as an opponent of Darwinism, especially among his American readers (Churchill, 1978; Bowler, 1985).

It was, however, in America that Weismann's ''death blow'' (Osborn, 1931, p. 528) paved the way for an opposing movement whose theoretical structure was already well-defined (Pfeifer, 1965, p. 161). While it

is rare to find any American neo-Darwinians even mentioned in past and present historiographies (Numbers, 1998, p. 36), the attack on the doctrine of the inheritance of acquired traits, the principle that subtended the evolutionary conceptions of Cope, Hyatt, Packard and many others, triggered the birth of the label "American neo-Lamarckism," a term intended to designate an anti-Darwinian philosophy (Bowler, 1985). As many historians have analyzed, Lamarck not only became a "convenient symbol" against neo-Darwinism (Gould, 1981, p. 672), but also came to epitomize a broader attitude toward ethics and society (Hofstadter, 1944; Stocking, 1962, 1968; Bannister, 1979; Moore, 1979; La Vergata, 1995). The transmissibility of ontogenetic variations represented a model for the theorization of a bio-cultural means by which organisms could learn from their environments, achieving ever higher stages of development (Stocking, 1968). Weismann's view problematized the idea of the interchangeability between biological inheritance and social learning, thus provoking a fierce debate among naturalists and psychologists. In this regard, critics of Weismann frequently focused on the deleterious moral and social implications of his hereditary model. In *The Present Problem of Heredity* (1891), the paleontologist Henry Fairfield Osborn described Weismannism as the triumph of fatalism:

> […] according to it, while we may indefinitely improve the forces of our educations and surroundings, and this civilizing nurture will improve the individuals of each generation, its actual effects will not be cumulative as regards the race itself, but only as regards the environment of the race; each new generation must start *de novo*, receiving no increment of the moral and intellectual advance during the lifetime of its predecessors. […] Thus, this important question is as complex in the spheres of mind and morals as it is in the lower physical and animal sphere. (Osborn, 1891, pp. 363–364)

Similarly, Ward saw in Weismann's evolutionary doctrine a deep downsizing of education. "The whole burden of the Neo-Darwinian song," he stated, "is: Cease to educate, it is mere temporizing with the deeper and unchangeable forces of nature" (1891, p. 65).

Prompted by such extra-scientific issues, the polarization between neo-Darwinian and neo-Lamarckian arguments favored the consequent hardening of scientific views in the late nineteenth-century evolutionary debate. To many naturalists, the defense of soft heredity implied the defense of a *Weltanschauung*, and this often turned the evolutionary debate into a much broader controversy among scientists entrenched

behind ideological splits. Edward Drinker Cope, the leader of the American neo-Lamarckian movement, epitomized such a process. His defense of his theory of "Diplogenesis," the idea that reiterated mechanical actions produce both germinal and somatic effects on organisms, led him to reject every extension or revision of the neo-Lamarckian theory. Especially in the 1890s, Cope wrote several essays in order to criticize any putative application of Weismann's studies to psychology. This embittered his personal relationship with his pupil Henry Fairfield Osborn and, most importantly, gave rise to a harsh dispute with the psychologist James Mark Baldwin.

Inheriting Somatic Impressions: Edward Drinker Cope and the Defense of Diplogenesis

Described by Stephen Jay Gould as "America's first great evolutionary theoretician" (1977, p. 85), Cope represented an authority in the American scientific community of the late-nineteenth century. During his short life he contributed nearly 1400 papers to scientific literature on herpetology, ichthyology and mammology (Frazer, 1902) and described 1282 fossils of vertebrates, about half of the total amount found in America in the years between 1846–1897 (Osborn, 1931, pp. 19–20). He began his career working on the herpetological collections of the Academy of Natural Sciences, pursuing the cataloging of reptiles and amphibians under Joseph Leidy's guidance. During his early research, he attended Leidy's course at the University of Pennsylvania between 1860–1861, learning the Cuvierian method of comparative anatomy. At the age of 28, Cope published his first detailed formulation of an evolutionary process in *On the Origin of the Genera* (1868), "quite independently" from Ernst Haeckel and Alpheus Hyatt's similar theorizations (Cope, 1896a, p. 8). In a dispute with Darwin and Wallace, he expounded an orthogenetic account of evolution based on embryonic accelerations and retardations which drove organisms toward different levels of life's hierarchy. Yet no mention of any Lamarckian process appears in the essay. Cope's first evolutionary process was due only to a morphological, endogenous, and not functionalist principle (Bowler, 1977; Gould, 1977). Cope turned toward a new account of evolution in the early 1870s with the publication of the essays *The Laws of Organic Development* and *The Method of Creation of Organic Forms* (1871a, b), where he began to explain fossil trends as the consequence of conscious movements on organic structures (*kinetogenesis*). Most of his work as a vertebrate paleontologist became

that of retracing the adaptive effects of use and efforts in the fossil specimens he had gathered during his geological surveys in the western states.[6] It is to be noted, however, that his first morphological and hierarchical conception of evolution continued to influence this later view (Bowler, 1983, 1985). Cope's explanations of vertebrate evolution emphasized that the more a structure was phylogenetically specialized, the more it was irreversible as well as binding for the future development of its taxonomic category. Organic plasticity thus had racial boundaries that constrained organisms' capability to change in response to environmental challenges.

The kinetogenetic theory became the core of Cope's conception of mechanical adaptation, which he fully developed in *The Origin of the Fittest* (1887a) and *The Primary Factors of Organic Evolution* (1896a). In 1887, Cope deepened his physiological argument by locating the origin of conscious movement in the anterior part of the brain. It was here that, after being registered in the posterior part of the hemispheres, the ''line of energy appears to be submitted to a disturbance which is a deflection, a process of turning or directing,'' that is to say, an ''exhibition of what is called a design'' (Cope, 1887b, p. 13). By sustaining this outlook, Cope was actually assuming the mastery of mind over matter, insofar as living phenomena were nothing but the result of energy determined by consciousness. In a letter sent to his daughter Julia in May 1886, he summarized his philosophy as follows:

> I can prove, I think, the preexistence of mind, i.e. as existing in living matter before it has developed complicated structures. In other words, structure has been produced by motion of the animal (theory of ''kinetogenesis''); and motion has been in the first place directed by sensation, or consciousness (a synonym, which is a quality of mind only). Is in the fact the foundation of mind, which with the assistance of memory has built up the minds of animal and men (Osborn, 1931, p. 534).

Cope used the word ''consciousness'' in the much broader sense of ''physical sensibility'' – that is, a fundamental receptive capacity shared by all living beings, regardless of their nervous complexity (1880, p. 261). The appearance of higher mental functions no doubt had followed the progressive evolution of the nervous system, yet basic sensory capabilities seemed consubstantial with life itself. ''Where the nervous system has not been certainly discovered,'' Cope stated in his contribution to the Johnson's Universal Cyclopædia, ''spontaneous move-

[6] On Cope's field research between the 1870s and 1880s, see Davidson (1997).

ments in the taking of food and moving from place to place are readily observed'' (1877, p. 872). Such movements, as in Protozoa, could only have had origin in consciousness (Cope, 1871b, pp. 257–258; Cope, 1887d, pp. 358–359). Though aimless movements had precedence in the order of time over conscious states, only the actions driven by the perception of internal states could influence the course of evolution (Cope, 1887a, p. 448). From 1882, Cope started referring to this principle as ''archaesthetism.'' In line with the conception of instinct as ''lapsed intelligence'' advocated by Herbet Spencer,[7] Cope maintained that all animal habits were movements originally acquired in consciousness, and then transmitted to the progeny as automatic behavioral patterns able to change their morphology (Cope, 1887a, p. 413).

Cope's assumptions not only dismantled Lamarck's materialist conception of the relationship between *physique* and *moral*,[8] but shared a lot of common ground with the hylozoist theories framed by such eighteenth-century physicians as Robert Whytt and Erasmus Darwin (Baertschi, 2005). Not surprisingly, Cope himself pointed out the resemblance between his doctrine of archaesthetism and Erasmus Darwin's thematization of consciousness:

> The doctrine that conscious states have preceded organisms in time and evolution I have called archaesthetism. It seems to have been first clearly formulated by Erasmus Darwin, who believed that growth has been stimulated by ''irritations'' (of hunger, thirst, etc.) and by the pleasurable sensations attending those irritations, and by exertions in consequence (Cope, 1896a, p. 505).

It is to be noted how Cope's evolutionary philosophy went far beyond the assumption of a biological principle driving organisms toward specialization and, in some cases, overspecialization. As a matter of fact, the doctrine of archaesthetism outlined a grey area between hylozoism, panpsychism, and pantheism, which left room for a purposive interpretation of evolutionary change that allowed Cope to reintroduce

[7] In 1855, Spencer defined the ''lapsing of reason into instinct'' as the outcome of the long-continued repetition of rational actions (p. 456). A further thematization of the doctrine could be found in George Henry Lewes's *Problems of Life and Mind* (1874).

[8] Cope admitted to having reframed Lamarck's original view in the light of a new metaphysics: ''Lamarck has attributed the movements of animals to the necessity of satisfying their instincts, without entering into the metaphysical questions which this involves. I have regarded the question as a metaphysical one by asserting that the necessary preliminary to movement is ''effort,'' referring to what are called ''voluntary'' as distinguished from automatic motions'' (Cope, 1896a, p. 497).

theism in nature (Cope, 1887e, pp. 527–528).[9] "The control of mind over matter," Cope stressed in another personal correspondence, "is the outcome of Neo-Lamarckian philosophy, which proves the supremacy of mind, and is therefore theistic, and entirely subversive of atheism" (Osborn, 1931, p. 541). Thus understood, evolution provided the evidence for a belief in God, properly intended as "a wider distribution of the mind" (Cope, 1889a, pp. 9–10), which endowed living beings with a creative power.

Soft heredity doubtless was a crucial point for Cope's neo-Lamarckian philosophy. Its denial would have broken the kinetogenetic causal chain that tied together consciousness and evolution. Thus not surprisingly, Cope began disputing Weismannism, employing every means in his power. Yet how could a self-taught paleontologist trained in comparative anatomy counter Weismann's experimental studies? Cope's first refined answer to Weismann came in 1889b with the publication of the essay "On Inheritance in Evolution" in *The American Naturalist*, which was later expanded in *The Primary Factors of Organic Evolution* in the section entitled "Heredity." Here the *pars destruens* consisted mainly of the enumeration of zoological and paleontological data apparently inconsistent with a neo-Darwinian view. As a matter of fact, Cope stated, neo-Darwinism was inconsistent with Darwinism itself since Darwin had provided many examples of inheritance of acquired characters, especially in his study of the face's muscular patterns (Cope, 1889b, p. 1058). As Ward would do a few years later, Cope further claimed that Weismann's theory suffered a great many methodological weaknesses. The attempt to disprove the inheritance of acquired characteristics by establishing the non-transferability of mutilations represented essentially a fallacious argument since mutilations and injuries, as a general rule, are not inherited. In 1896 Cope even admitted to have replicated Weismann's mice experiment. His conclu-

[9] Cope's archaesthetic doctrine received various critiques by his contemporaries, the most important of which was that proposed by the Scottish-American philosopher and physician Edmund Montgomery. In a series of essays published in *The Open Court* between 1887–1888, Montgomery charged Cope with misunderstanding the relationship between mind and matter: "Professor Cope has failed to realize that the imparting of direction to matter is as much a physical act as the imparting of any other mode of motion" (1887, p. 163). On August 18, 1887, the American physician Shobal Vail Clevenger sent a letter to the editors of the same journal highlighting the frailties of Cope's pantheistic view: "The probability of a primitive mundi in a primitive substance would appear to the physiological chemist to be unnecessary and panimistic, which, with an anthropomorphic twist, becomes pantheistic; all of these conceptions being more sentimental than reasonable, and as incapable of proof as their denial. So that existence of a Supreme Being is neither probable nor improbable" (1887, p. 389).

sions were clear: mutilations, from the breakage of a woman's hymen to circumcision, had never led to any change in germplasm. This is because each of these phenomena appears only occasionally in ontogeny and is not connected with the individual "metabolic physiology" (Cope, 1896a, p. 400). The point was that paleontologists and naturalists should be concerned not with mutilations or sudden changes, but with needs, habits, mechanical adaptation, and, most importantly, geological times. As Cope had widely discussed in his works on mammalian evolution, limbs and dental cusps had evolved through strains and efforts whose effects had been inherited down through generations (1875, 1887c). Likewise, Hyatt's works on the evolution of Cephalopods seemed to provide more paleontological evidence of the inheritance of acquired characters. As traits once acquired mechanically (i.e., the pressure zones in shells' convolutions) continued to appear without their original environmental cause, soft heredity appeared as an unavoidable inference (Hyatt, 1893b; Cope, 1896a, p. 405).

Such negative reasoning based on the logical improbability of the neo-Darwinian explanation had the main effect of splitting the debate even further (Osborn, 1895, p. 418). To critics, the paleontological facts adduced by Hyatt and Cope in favor of soft heredity were anything but "crucial test-cases" (Romanes, 1895, p. 63). Alfred Russel Wallace, the co-founder of the theory of natural selection and a strong supporter of Weismann's theory, highlighted that Cope's fossils interpretation did not imply the validity of the inheritance of acquired characteristics, since "the very same results could have been brought about by variation and natural selection" (1889, p. 424). In all probability, Cope was aware that adducing paleontological facts was not enough to counter neo-Darwinism; thus, he also tried to attack Weismann on Weismann's own epistemological level. In "On Inheritance," he referred to various histological and embryological case-studies:

> In the first place, since the reproductive cells are derived from the segmentation of the fertilized ovum, they partake of all the characters, whatever they may be, which both parents contribute to the latter, in common with all of the other cells so derived. Now, since the other or "somatic" cells develop the modifications which constitute evolution in their subsequent growth into organs, there is no reason why the reproductive cells which experienced similar influences should not develop similar characters, so soon as they also are prepared to grow into organs. That such influences are experienced by the germ cells is rendered the more probable by the fact that their appearance after segmentation is often not immediate. In

> some of the rodent mammalia they do not appear until the thirteenth day after the first appearance of the blastoderm. Furthermore the isolation of these cells is not complete after they appear. The continuity of the reticular structure (cytoplasm) of the cells has been repeatedly demonstrated, an arrangement which is essentially connected with their nutrition. So long as nutrition of the germ-cells continues, the building of structure in which they become the chief agents must be for this reason also subject to the influences which are experienced by all the other cells of the body, under the strains and other stimuli derived from the interaction of the individual and its environment. (Cope, 1889b, pp. 1060–1061)

Cope termed the interaction between somatic modifications and germ variations "Diplogenesis." In order to explain it, he outlined the following model based on an imaginary parthenogenetic organism. By regarding S as the set of somatic traits, g as the hereditary constitution, *A* as a new somatic modification, and *a* as its counterpart in the germplasm, Cope stated that for every character *Aa*, the organism at its initial state S + g can acquire new characters in the following sequence: Sa^1 $g(a^1)$, Sa^1a^2 $g(a^1a^2)$, and so on (1889b, pp. 1061–1062). These characters could, however, result from various levels of interaction among germplasm, development, and environment. First, germ cells were anything but a segregated biological material, and thus could at first incur variations due to pathological or chemical influences. One of the most discussed cause of these "gonagenic" variations was "telegony," that is, the influence of a previous mate on the genetic constitution of the female parent.

Originally based on the idea of blending hybridization, telegony represented a distinguishing issue in nineteenth-century biology. Darwin himself discussed cases attributable to telegony and xenia – e.g., telegony in plants – in *On the Origin of the Species* (1859) and in *The Variations of Plants and Animals under Domestication* (1868). Though the rise of Mendialian genetics profoundly challenged its theoretical basis (Burkhardt, 1979), discussions of telegony had taken on a specific meaning for evolutionists between the 1880s and the 1890s. In particular, many advocates of soft heredity had regarded such process as a key argument against Weismannism.[10] Herbert Spencer, for instance, considered telegony as "an absolute disproof of Prof. Weismann's

[10] On the contrary, George Romanes stated: "I agree with Professor Weismann in holding that the facts of telegony (supposing them to be facts) are as compatible with the theory of germ-plasm as with the gemmules […] or any other theory which postulates a centripetal flow of the carriers of heredity from somatic-cells to germ-cells" (1893, p. 191).

doctrine that the reproductive cells are independent of, and uninfluenced by, the somatic cells'' (Spencer, 1893b, p. 755). The use of telegony to substantiate theories about inheritance gave the United States a remarkable role in the international debate, especially as far as human telegony was concerned. Spencer himself looked for proof of telegony in America to be used in the dispute with Weismann. Indeed, he asked whether prominent evolutionists such as Cope and Marsh had ever noticed evidence from the interbreeding between blacks and whites:

> A correspondent draws my attention to the fact that a phenomenon parallel to that which I have narrated in the second essay on ''the Inadequacy of Natural selection,'' concerning the Quagga, has been observed in the United States, when white women have borne children to negroes. Here is the passage: ''The children of white women by a white father had been repeatedly observed to show traces of Black blood in cases when the woman had previous connection with 'a negro.'''[11] I should like to be able to give something like scientific verification of this [...] but can you yourself tell me anything about it, or can you tell me of any physiologist in the Southern States, who is likely to have personal knowledge? (Spencer to Cope, March 8, 1893, HCQC)[12]

New variations could also emerge in organisms with sexual reproduction during the fertilization between gametes, since during the first phases of cell division anomalies in segmentation could give rise to a third type of variability: embryogenic variations. The fourth and final kind of interaction was that of ''somatogenic changes,'' namely, those modifications that occur starting from the larval phase through the interaction between ''strength of hereditary development, individual and environment'' (Cope, 1896a, p. 444).[13] Once one of these ontogenetic changes became hereditary, it would enter into the domain of phylogenetic changes, thus becoming significant from an evolutionary point of view.

[11] Such thematization of ''Negroid blood'' as to its capacity to affect pure-white lineages sheds light on how racial formalism, namely, the idea that certain characteristics define the superindividual organic identity of a race (Stocking 1968, p. 194), permeated the nineteenth-century biological and anthropological discourse.

[12] Edward Drinker Cope Papers (MC 956), Quaker & Special Collections, Haverford College, Haverford, PA, USA. Miscellaneous letters; hereafter cited as HCQC. According to Spencer, Cope never seemed to have answered him: ''Professor Cope of Philadelphia has written to friends in the South, but has not yet sent me the results'' (1893b, p. 754).

[13] See also Osborn (1895, p. 426).

The idea that variations can be acquired in multiple ways was certainly hard to maintain from both an experimental and a theoretical standpoint. What most neo-Lamarckians did was to ground their thesis on the well-known analogy between memory and biological inheritance, introduced by the German physiologist Ewald Hering in 1870. On the occasion of the 30th anniversary of the Imperial Academy of Natural Sciences of Vienna, Hering delivered his lecture "Über das Gedächtnis als eine allgemeine Funktion der organisierten Materie" [On Memory as a General Function of Organized Matter], where he maintained that the nervous system could transmit the nerve fibre "vibrations" to the whole organism, including the gametes. Once a stimulus was perceived, it could be transferred from one generation to another, thus making ontogeny a "record of memory" (Gould, 1977, p. 99). Such interpretation spread in the Anglo-Saxon context thanks to the British novelist Samuel Butler, who fully translated Hering's paper in his *Unconscious Memory* (1880).[14]

The idea that both memory and biological inheritance were based on the "persistence of vibrations" (Butler, 1880, p. 96) became the reference point for many of the advocates of soft heredity.[15] Furthermore, it provided a system which emphasized the role of mental factors in evolution, since the nervous system was considered a pervasive and integrated entity able to influence the germplasm. Not surprisingly, one of the most popular neologisms employed by American neo-Lamarckians for describing the transmission of characters from somatic cells to germ cells was that of "Mnemogenesis" (Hyatt, 1893a, p. 73). In *The Primary Factors*, Cope defined such a process, quoting Hering's original paper, and then adding:

> If heredity is a form of memory, its laws may resemble those of the psychic memory. In the latter, everything depends on what we call the strength of the impression. A single impression is often easily forgotten, and the certainty of recollection is largely dependent on the frequency of repetition of the stimulus. This is the essence of mental education, and it is probably the law of education of the germ-plasma as well. (Cope, 1896a, p. 493)

Following Hering's analogy, for Cope, the building of the embryo became "the unfolding of a record or memory, which is stored in the

[14] For a broader analysis, see Gould (1977), Forsdyke (2006), and Turbil (2017).

[15] In this regard, Cope wrote: "Hering has identified this property of the original cells with the faculty of memory. This is a brilliant thought, and, under restriction, probably correct" (1887a, p. 407).

central nervous organism of the parent, and impressed in greater or less part on the germ-plasma during its construction, in the order in which it was stored'' (1896a, p. 493). Embryonic development was nothing but the result of those countless influences received from ancestors. How the germplasm could be modified by ''impressions'' remained, however, a puzzle to solve. Doubts about the material implied in the process accompanied almost every discussion of the issue, and Cope was forced to admit that ''the manner in which influences which have affected the general structure are introduced into the germ cells remains the most difficult problem of biology'' (1889b, p. 1064). In this regard, Cope distinguished two main schools of thought on the subject: those who grounded the interaction between somatic cells and gametes on some discreet and molecular basis and, conversely, those who rooted diplogenesis in the nerve connections. The most famous example of the discrete view was probably the theory of pangenesis discussed by Darwin in *Variations of Animals and Plants under Domestication* (1868) and expanded by William Keith Brooks in *The Law of Heredity* (1883). Cope strongly opposed such an idea, as it was quite impossible for him to imagine that ''gemmules'' derived from a given part of the organism would have found their exact place in the growing embryo. Each particle, he stated, should find its way through circulation, or otherwise transmit ''its peculiar mode of motion to the correct molecules of the embryo, without error as to locality'' (1889b, pp. 1068–1069). A few years later, Hyatt expressed the same concern about Darwin's hypothesis of pangenesis. Every corpuscular theory of inheritance, he maintained, implied the existence of unknown particles' circulation and allocation processes:

> One has to imagine the corpuscles and all this active circulation and concentration taking place invisibly and yet requiring visible vehicles of transmission in the minute spermatozoon and nucleus of the ovum. Then he must picture their redistribuition over the body of the offspring, the larger number remaining latent until the proper time arrives for them, and then locating themselves and coming out in exactly the right place, or repeating at the right time some tendency or habit of the ancestors. These appalling difficulties rest upon an original assumption that has to be propped up by a series of secondary hypothesis, not one of which offers a single visual fact to justify its invention. (Hyatt, 1893a, pp. 69–70)

Cope endorsed Hyatt's critique, which he republished in *The Primary Factors*. Since every model of inheritance based on the transmission of

particles "must account for a difficulty as great as that of the camel and the needle's eye" (Hyatt, 1893a, pp. 69–70), the transmission of "a mode of motion" organized in a central nervous system was less inconceivable (Cope, 1889b, p. 1069; 1896a, p. 451).

By endorsing Hyatt's critique, Cope was actually opposing every account of evolutionary change which dismissed Hering's dynamic interpretation of biological inheritance. For the same reason, in the years immediately following the publication of "On Inheritance," Cope had to defend his theory of Diplogenesis not only against staunch neo-Darwinians like Weismann and Wallace, but also against those who were trying to redefine the relationship between behavior, development, and heredity in a manner that reached a compromise between neo-Darwinian and neo-Lamarckian views. These included George Romanes, who long tried to maintain a "pluralist" approach in post-Darwinian debates, and Henry Fairfield Osborn, the disciple of Cope who reshaped his first views in the light of Weismann's criticisms.

In the winter of 1889–1890, Cope exchanged letters with George Romanes regarding misconceptions that were plaguing the debate between neo-Darwinians and neo-Lamarckians. In a letter dated January 4, 1890, Romanes tried to persuade Cope that the neo-Lamarckian and the "true Darwinian school" shared the same theoretical assumptions. Their "philosophical difference," Romanes claimed, was just due to "a want of understanding an argument with respect to terms" (Romanes to Cope, January 4, 1890, HCQC). A widespread misconception among neo-Lamarckians was the idea that natural selection is concerned with the causes of individual variations. "All Darwinists," Romanes wrote, "will agree that 'congenital variations' 'only furnish the material of the struggle' for existence – and hence the condition (or the data) to the process of natural selection" (Romanes to Cope, January 4, 1890, HCQC). Natural selection could not explain the origin of variations in the same way the theory of light didn't specify the cause of light ondulations. Yet natural selection could be regarded as the main mechanism in the origin of permanent varieties, since "a species is not brought into existence suddenly by way of a simple congenital variation ('sport'), but by an accumulation of such variations in successive generations" (Romanes to Cope, January 4, 1890, HCQC). Given the struggle for existence and the variability and transferability both of congenital and acquired changes,[16] natural selection had all it needed to work as a theory, and Cope himself seemed to allow all these precon-

[16] Here Romanes emphasized: "and as I believe also acquired" (Romanes to Cope, January 4, 1890, HCQC).

ditions. Excluding Weismann, Romanes concluded, "I do not think anybody has suggested that "heredity" *per se* is the cause of them [variations]. I myself think that Weismann is wrong, and agree with you in holding to Lamarckian principles" (Romanes to Cope, January 4, 1890, HCQC).

Despite Romanes's arguments, Cope continued to criticize every deployment of the Lamarckian logic out of his own interpretation. Even his pupil Osborn was not spared, as Osborn had written in the summer of 1889 that natural selection still represented "the only explanation that can be offered of the origin of one class of useful and adaptive characters" (Osborn, 1889, p. 561). In response, Cope wrote to Osborn on September 27, 1889: "I agree with your position in the main, but I do not admit the Natural Selection ever originated anything. To suppose so is to my mind a logical fallacy – (I) I should say illogical, – or as Kant would say, an imitation only of logic, a 'paralogism'" (Osborn, 1931, p. 393).

The examples here analyzed well convey the intensity of the debates in which Cope was involved during the 1890s. In a July 31, 1892 letter to his wife Annie, he admitted to being literally swamped with papers and books, writing: "I have a great stock of books and papers from all quarters to go over" (Osborn, 1931, p. 398). Nevertheless, his most interesting confrontation of this period was that with the Princeton psychologist James Mark Baldwin.

Social Learning and Environmental Acquisition: the Debate Behind the "Baldwin Effect"

During the last few decades, a number of historians have revisited the figure of James Mark Baldwin (Continenza, 1984, 1986; Richards, 1987; Weber and Depew, 2003). It has been widely suggested that the so-called "Baldwin effect," as George Gaylord Simpson called it (1953), represented in a way a theoretical hybridization between Darwinian and Lamarckian principles, a simulation of Lamarckism by means of Darwinian mechanisms. At least in part, the co-authors of the theory of organic selection, namely Baldwin, Conwy Lloyd Morgan, and Henry Fairfield Osborn, were triggered by the same need: to reshape the mental dimension of evolutionary change in response to the Weismannian turn. However, both the premises and the articulations of their works showed significant divergences. Behind the need to conform their ideas to the groundbreaking work of Weismann, their appeal to organic

selection had heterogeneous motives which were rooted in different theoretical backgrounds (Bowler,1989, p. 263; Hall, 2001). The psychologists Lloyd Morgan and Baldwin, who both endorsed Darwin's selectionist view, employed organic selection to counter the conception of instinct as lapsed intelligence championed by Spencer and neo-Lamarckians (Depew, 2003, pp. 7–10). On the other hand, Osborn saw in organic selection an auxiliary tool to overcome the dead end of soft heredity without prejudicing Cope's progressionist idea that evolutionary changes first appear as directional variations in ontogeny (Baldwin, 1902, p. 336).

Though Baldwin, Morgan, and Osborn, while differing "from one another about what and how much to save" (Depew, 2003, p. 4), may be considered to have preserved some features of Lamarckism from hard inheritance, it is not difficult to understand why they raised both Cope's interest and perplexity. Starting with his *Mental Development in the Child and the Race* (1895a), Baldwin outlined a third way between the idea that organisms undergo their environments being directly shaped by them and Cope's archaesthetic doctrine. Like Cope, Baldwin allowed consciousness a role in directing evolution, yet he disputed both Cope's way of conceiving organisms' conscious activity and the idea that the reorganization on nerves could be transmitted to descendants (Richards, 1987, p. 472). By incorporating children's learning processes into the biological concept of ontogenetic adaptation, Baldwin stated that ontogenetic accommodations socially acquired could influence the direction and rate of evolutionary change. Behavioral adaptations, even without causing any germinal transmission of habits or acquired traits, would allow organisms to survive as long as there was a concurrence between ontogenetic modifications and congenital variations, thus triggering natural selection.

Whereas the "transmissionists" (Morgan, 1896, p. 309) considered behavioral adaptations to be the direct cause of germ-line variations, Baldwin and his supporters reframed the causal chain between behavior, ontogeny, and phylogeny. In Morgan's terms, where a variation v is similar in direction to an ontogenetic modification m, the organism has an added chance of survival from the coincidence $m + v$ (Baldwin, 1902, p. 348). Thus understood, this concurrence resulted in an "apparent" transmission of acquired characters (Osborn, 1897a, p. 584) that made many of the facts adduced by Lamarckians interpretable in terms of natural selection.

Baldwin's *Mental Development* represented the first step[17] in the thematization of what he would later consider a new factor in evolution (1895a, pp. 165–167). One of the first reviews of the volume was published in Cope's own journal *The American Naturalist* in July 1895. It appeared in the section on psychology directed by William Romaine Newbold, Adam Seybert Professor of Intellectual and Moral Philosophy at the University of Pennsylvania, who praised the volume as "a most important contribution both to biology and psychology" (p. 693).[18] Yet the dispute with Cope started just one month later in the pages of *Science*. On August 23, Baldwin published a paper focused on the psychological basis of the kinetogenetic theory. The core of Baldwin's critique was Cope's way of conceiving neo-Lamarckism as the sole evolutionary theory that made room for psychological factors. Most of this criticism, Baldwin admitted, was directly fueled by Cope's article "The Present Problems of Organic Evolution" (1895), published on July 23 on *The Monist*. Here Cope had dismissed any possible bond between mental factors and the neo-Darwinian theory of evolution. "Sensation or states of consciousness," Cope claimed, played a pivotal role only in those "epigenetic" processes due to post-embryonic changes transmissible to offspring (pp. 572–573). To this, Baldwin replied: "Being struck with this I wrote to Professor Cope – the more because the position ascribed to consciousness seemed to be the same, in the main, as that which I myself have recently developed from a psychological point of view in my work on *Mental Development*" (1895b, p. 219). According to Baldwin's theory of social heredity,[19] it was not necessary to summon soft heredity to explain what a child could learn spontaneously from his social environment. "The child," Baldwin stated, "really inherits the details; but he inherits them from society by this process of social growth, rather than by direct natural inheritance" (1895b, p. 220). Likewise, moral and intellectual progress appeared to be explainable in terms of social accommodation rather than epigenetic acquisitions.[20]

[17] In this regard, Richards states: "In *Mental Development*, Baldwin used the term 'organic selection' to refer only to his theory of individual learning, the theory in light of which he proposed that social heredity formed a line of transmission parallel to and usually quite separate from that of biological heredity" (1987, p. 488).

[18] In the September issue, Baldwin defined Newbold's review as "cordial and appreciative" (Baldwin 1895c, p. 873).

[19] As Baldwin would allege in 1897, the expression "social heredity" was to be preferred to Lloyd Morgan's term "tradition," for it better emphasized the direct relationship between one human mind and the next (1897, p. 558; Griffiths 2003, p. 199).

[20] "I fail to see any great amount of truth in the claims of Mr. Spencer that intellectual progress in the race requires the Epigenetic view." (Baldwin 1895b, p. 222).

Baldwin's attacks on Cope's neo-Lamarckian system became public during the annual meeting of the American Psychological Association held in Philadelphia on December 1895. Both Cope and Baldwin delivered their lectures in the section "Consciousness and Evolution" on December 28th. The panel was introduced by William James, who outlined some possible configurations of the relationship between biological evolution and consciousness. Cope followed James, highlighting how neo-Lamarckism allowed naturalists to reevaluate the creativeness of mental factors in evolution. Baldwin, who took the floor after Cope, replied that new research on infant development made Cope's arguments pointless. "Prof. J. Mark Baldwin," Newbold wrote in his conference report, "commented upon several points of Prof. Cope's argument, drawing special attention to the fact that recent investigation into the effect on young children of their surroundings makes it more easy to account for adaptation without reference to inheritance of acquired aptitudes" (1896, p. 159).

The break between Cope and Baldwin was by this point irreversible. In the eyes of Cope, organic selection would melt the diplogenetic logic into the far vaguer concept of social heredity. Consciousness was indeed for Baldwin the main medium of social influence, while for Cope it continued to represent the elemental condition in the acquisition of transmissible changes. Despite the same emphasis on mental factors, they disagreed on the nature of the transmission of consciously acquired habits and the epistemological necessity of soft heredity.

The debate ran in the pages of *The American Naturalist* until the summer of 1896. For more than three months, the psychology section of the journal became their battleground. Cope decided to republish Baldwin's first attack in his journal in March (Baldwin, 1896a). A first reply came in April, where Cope indicated that Baldwin was questioning the fundamental connection between Diplogenesis and the notion of instinct as "lapsed intelligence."[21] "Prof. Baldwin," Cope stated, "denies the necessity of the Lamarckian Factor, he admits it in this doctrine of selection; and his denial of inheritance, only covers the case of psychological sports" (1896b, p. 345). By doing so, Baldwin was dismantling the neo-Lamarckian bond between habits, efforts, and biological change. Social heredity was certainly a significant phenomenon in humans, yet "it was not heredity" and thus "should have a new name,

[21] In the paper "Heredity and Instinct" (1896), published in the March issue of *Science*, Baldwin had indeed stated: "I wish to suggest some considerations from the psychological side, which seems to me entirely competent [...] to show [...] that the instincts can be accounted for without appeal to the hypothesis of "lapsed intelligence," as the use-hypothesis, as applied to this problem of instinct, is called" (1896b, p. 438).

which shall be less confusing'' (Cope, 1896b, p. 345). In Cope's view, Baldwin's work was the reflection of Weismannism on psychology. He himself wrote to Osborn on April 9, 1896: ''[Baldwin] hasn't got Lamarckism in his head, but is a pure Neo-Darwinian. His psychological views are affected accordingly'' (Osborn, 1931, p. 459). Neo-Darwinism was about to collapse and in no way Baldwin's replies would have been ''good enough to demonstrate social heredity as the cause of mental evolution'' (Osborn, 1931, p. 459).

Baldwin's answers came in May, and here he stressed how trans-generational acquisitions do not necessarily require the Lamarckian factor (1896c, p. 422). Cope's theory, Baldwin critically stated, ''requires the acquisition of new movements, new adaptations to environment, by a conscious selection of certain movements which are then carried out the first time by the muscles'' (1896c, p. 426). According to Baldwin, such a view violated a fundamental principle: namely, that no action can be conscious without having been previously recorded. Thus animal behaviors started as *overproduced movements* or *movement variations*, being selected in the same way ''creatures are selected from overproduced variations by the natural selection of those which are fit'' (1896c, p. 427). This was the process of organic selection,

> a phrase which emphasizes the fact that it is the organism which selects from all its overproduced movements those which are adaptive and beneficial. The part which the intelligence plays is through pleasure, pain, experience, association, etc., to concentrate the energies of movement upon the limb or system of muscles to be used and to hold the adaptive movement, ''select'' it, when it has once been struck. In the higher forms both the concentration and the selection are felt as acts of attention. (Baldwin, 1896c, p. 427)

Contrary to what Cope continued to claim in his papers, many scientists were questioning soft heredity in response to Weismannism. The emergence of the theory of organic selection in the works of Baldwin, Lloyd Morgan and, most importantly, Cope's own pupil Henry Fairfield Osborn, demonstrated that neo-Darwinism was affecting the scientific community. It was anything but a dead theory:

> [Cope] says: ''But since the biologists have generally repudiated Weismannism,'' etc. This is a curious saying; for my impression is that even on the purely biological side, the tendency is the other way. Lloyd Morgan has pretty well come over; Romanes took back before he died many of his arguments in favor of the Lamarckian factor; and here comes a paleontologist, Prof. Osborn, – if he is

> correctly reported in Science, April 3rd, p. 530 – to argue against Prof. Cope on this very point with very much the same sort of argument as this which I have made. (Baldwin, 1896c, p. 424)

Here Baldwin referred to the address Osborn had delivered at the meeting of the New York Academy of Science on March 9, 1896. Replying to Arnold Graaf's defense of soft heredity, Osborn exposed what he later regarded as an hypothesis in some degree new:

> During the enormously long period of time in which habits induce ontogenic variations, it is possible for natural selection to work very slowly and gradually upon predispositions to useful correlated variations, and thus what are primarily *ontogenetic variations* become slowly apparent as *phylogenic variations* or congenital characters of the race. (1897a, p. 584)

It is not difficult to understand Baldwin's stress on Osborn's words. In a way, he seemed to turn the pupil against the master, since Osborn had advocated Cope's neo-Lamarckian theory until the early 1890s. In *The Primary Factors*, Cope himself had regarded Osborn's essay "The Paleontological Evidence for the Transmission of Acquired Characters" (1890) as one of the chief studies in support of the American neo-Lamarckian school of paleontology (1896a, pp. 521–523); and regarding this Osborn had already begun to show doubts about the use-inheritance theory when applied to non-plastic structures such as teeth and horns (1890, p. 111).[22]

In a way, Baldwin's emphasis on the Weismannian turn facilitated Cope's replies and triggered all the anti-Darwinian arguments he had maintained for decades. In an article he published in the same May issue, Cope stressed how Baldwin's theory of intelligent selection was not only entirely explainable in neo-Lamarckian terms, but that it showed the same epistemological problems of natural selection, since it "stands on the same basis as all the other theories of natural selection as explanations of the origin of anything new" (1896c, p. 429). For the

[22] Osborn came to know about this criticism from the letter exchanges he had with the British biologist Edward Bagnall Poulton (Osborn, 1907, p. 235). In 1891, Poulton, together with Alfred Rusel Wallace and the British physician Charles S. Tomes, had indeed carried out a strong critique of the neo-Lamarckian interpretation of the origin of teeth: "It may be reasonably objected that the most elementary facts concerning the development of teeth prove that their shapes cannot be altered during the lifetime of the individual, except by being worn away. The shape is predetermined before the tooth has cut the gum. Hence the Neo-Lamarckian School assumes, not the transmission of acquired characters, but the transmission of characters which the parent is unable to acquire!" (Weismann, 1891, 437n).

same reason, organic selection could work only when operating on designed acts driven by inner sensitiveness. Moreover, its range of application seemed to be limited since social heredity appeared "mainly restricted to the higher animals and to man" (Cope, 1896c, p. 429). By overvaluing social imitation, Baldwin was thus understating what an organism can physically acquire by means of pleasure, pain, and associations. The inheritance of insanity and defective brain mechanisms in family lines, as well as of any structural adaptations, were nothing in Cope's view but the outcome of more vigorous forms of environmental education based on the diplogenetic process. Baldwin had thus lost the "intimate connection between mind and its physical basis" (Cope, 1896c, p. 430) involved by the dynamic conception of heredity. He had forgotten that "the inheritance of mental characteristics is as much a fact as the inheritance of physical structure, and for the reason that the two propositions are identical" (Cope, 1896c, p. 430).

Despite Cope's harsh criticism, Baldwin's paper "A New Factor in Evolution" was published in *The American Naturalist* in June and July. Organic selection was now defined as that "process of ontogenetic adaptation considered as keeping single organisms alive and so securing determinate lines of variation in subsequent generations" (Baldwin, 1896e, p. 552). Evolution, in turn, was driven by those learned behaviors that affect biological change becoming phylogenetically entrenched. By keeping organisms alive until the emergence of useful variations, individual accommodations channeled the action of natural selection, thus giving "direction to evolution" (Baldwin, 1902, p. 173).

Starting from 1897, the divergences between the Baldwin supporters became increasingly apparent. Osborn, in particular, distanced himself from his collegues' research program by pointing out two limits of neo-Lamarckism and neo-Darwinism that the theory of organic selection had failed to overcome. In the first place, the idea that certain bone structures had emerged through individual accommodation led to the same difficulty that affected the neo-Lamarckian theories: namely, that these structures hardly exhibit any form of plasticity during ontogeny (Osborn, 1897b, p. 950). Through utilization, Osborn highlighted, teeth could rather undergo deterioration and consumption.[23] Most importantly, Osborn urged against Baldwin and Morgan insofar as they had maintained that organisms' ability to change in response to new con-

[23] To this critique Baldwin replied: "These cases do militate against Lamarckian inheritance, but not, I think, furnish exceptions to the operation of organic selection; for the deterioration of the teeth by use would only make more necessary the cooperation of muscular and other accommodations, while variations in the teeth were accumulating" (1902, 337n).

ditions was in itself a result of natural selection. "It appears," Osborn pointed out, "that Organic Selection is a real process, but it has not yet been demonstrated that the powers of self-adaptation which become hereditary are only accumulated by selection" (Osborn, 1897b, p. 950). A large part of phyletic progressions should be traced back to determinate variations due to "an inherent power or function of protoplasm" (Osborn, 1897b, p. 949).[24]

Baldwin ratified Osborn's theoretical divergence in his volume *Development and Evolution* (1902), where he devoted an entire paragraph to Osborn's ambiguous use of the term "determinate variation." According to Baldwin, Osborn was actually stating that phyletic lines were determined by pre-adapted variations, an inference by no means necessary since organic selection secured evolutionary directionality as well: "On this view the determination is secured, not by an original balance of variations in one direction, but by a shifting of the mean of variation in a certain direction through the selective results of the creature's accommodations" (1902, p. 163).

Osborn's rejection of organic selection is not hard to understand, since his paleontological work was rooted in Cope's orthogenetic view of evolutionary progress. For his part, Cope never denied the supplementary value of social heredity in biological evolution, especially in complex organisms where imitation has a pivotal role. The real issue was admitting a causative bond between social learning and phylogenetic acquisition. "That Baldwin's 'social heredity' has its place I have no doubt," Cope wrote to Osborn on June 25, 1896, "but its relation to general evolution is about like that of the invention of the steam engine to it" (Osborn, 1931, p. 460).[25]

Conclusions

Cope died in the fervent phase of debate over soft heredity, a few years before the rediscovery of Mendel's laws of inheritance. He continued to defend his staunch anti-Darwinian position until his last days, countering not only Weismann and Wallace but also any compromise between Lamarckism and Darwinism displayed by a new generation of

[24] With the turn of the century, Osborn reframed the relationship between determinate variation and evolution within his well-known theory of "aristogenesis." According to it, evolutionary novelties arise through a "creative process" of "geneplasm" variation "in the direction of future adaptation" (1934, p. 210).

[25] In the *post scriptum* of the same letter, Cope warned Osborn: "The Psychologists don't know much about Evolution. Lookout for them!" (Osborn, 1931, p. 460).

naturalists and psychologists. Cope's skepticism and criticism of organic selection and social heredity were not just reflections of his being a militant paleontologist (Osborn, 1931) and passionate polemicist. The dispute with Baldwin represented one of the outcomes of the late-nineteenth-century break between biological inheritance and social learning. In all likelihood, Cope felt that Baldwin's theoretical step would have relocated in a neo-Darwinian framework those "agency-accentuating effects" once monopolized by neo-Lamarckians (Depew, 2003, p. 13). As an extension of Weismannism to psychology, this would have, in turn, recast intelligence and consciousness materialistically, fueling the arguments of those who thought, in Cope's words, "that non vital force evolves life" (Osborn, 1931, p. 537).

Paradoxically, one of Baldwin's lead arguments against Cope was that, beyond the too vague nature of the archaesthetic doctrine, neo-Lamarckism could lead to a form of biologistic reductionism which did not recognize social heredity as an autonomous factor in evolution. Assuming that mental habits are as inheritable as physical traits, Cope and the neo-Lamarckians were actually "nature hard-liners" (Hoffmeyer and Kull, 2003, p. 254) ready to cast nurture acquisitions as a part of the biological sphere. Referring to Cope's theory in 1902, Baldwin wrote that a strict application of the doctrine of lapsed intelligence and of the inheritance of acquired habits would have detuned organisms' mental plasticity: "If Lamarckism were true we should all be, to the extent to which both parents perform the same acts (as, for example, speech) in the condition of the creatures who do only certain things and do them by instinct" (p. 55). Baldwin's criticism was thus explicit: if children's nervous material is biologically set in our ancestors, no plastic substance is left to learn anything with. On a closer inspection, Cope's stress on the racial boundaries in mental education mirrored this conception of organic plasticity. By claiming that the African mind underwent more or less of an eclipse with sexual maturity (1890, p. 2053), Cope was indirectly ratifying that his "vigorous" form of environmental education had weighty limits and constraints.

In line with many other forms of nineteenth-century cosmic philosophies, Cope shared an essentially deterministic view of progress and maintained that moral, cultural, and social development were a continuation of biological evolution. His concern about Weismannism was partly a direct consequence of conceiving moral and social evolution to be ruled by the same natural laws that had driven biological change. Furthermore, to deny soft heredity would have undermined a model that, in Cope's terms, offered evidence for the belief in a Supreme

Mind (Cope, 1887b). In his critical responses to Baldwin, Cope was thus reacting to that first, fundamental separation between biological inheritence and cultural transmission that Baldwin's works helped to spread in American social sciences at the end of the century (Stocking, 1968; Bowler, 1983, p. 105). As an epistemological emancipation of social and cultural phenomena from evolutionary biology, the separation threatened both Cope's biologistic stance and his attempt to preserve design in nature by emphasizing the mental foundation of evolutionary change.

Acknowledgements

I would like to thank the Consortium for History of Science, Technology and Medicine of Philadelphia for the support received from the 2015–2016 Research Fellowship. I am also grateful to Dr. Phillip Honenberger for his feedback and to my supervisor Prof. Barbara Continenza.

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