

# The Naturalist and the Emperor, a Tragedy in Three Acts; or, How History Fell Out of Favor as a Way of Knowing Nature

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**M**Y SUBJECT IS A CRUCIAL EPISODE in the story of how historical explanation fell out of favor as an element of naturalist understanding: how history found itself banished from science. This is a subject close to my heart since I teach at Stanford, where the social and intellectual world, at least among the students, is divided into the Techies and the Fuzzies. Mine of course are the Fuzzies, but it's a deeply unjust misnomer: they are as rigorous and empirical as any engineer. More to my point here, the Techies' intellectual world is greatly limited by its segregation from their world, my Fuzzies', and specifically, from historical knowledge as a mode of naturalist scientific understanding.

But I meant to begin not at Stanford, but with Napoleon. Bear with me. I want to begin with Napoleon's disdain for historical and philosophical forms of explanation in science, and his preference for a scientific approach that was specifically neither philosophical nor historical.

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## Act 1. The Emperor Shows the Naturalist Withering Scorn

Napoleon cherished a well-publicized hatred of abstract ideas, which he considered to be (I'm paraphrasing) airy-fairy nonsense. He disliked intellectuals, for whom he repurposed the neologism "ideologue"—which the *philosophe* Destutt de Tracy had recently coined during the Revolution to denote practitioners of a new, modern science of ideas—into the political epithet it is today.<sup>1</sup> Napoleon saw himself as a man of action and a pragmatist with no time for ivory tower frivolities. His valet, Louis Constant Wairy, told the story of one evening in the autumn of 1804, soon after Napoleon's arrival in Mainz on his grand tour of imperial inspection, when his metaphysically minded arch-chancellor, Jean-Jacques-Régis de Cambacérès, began to expound the principles of Kant. Napoleon cut him off, dismissed the sage of Königsberg as "obscure," and abruptly left him. The disgruntled Cambacérès sought refuge with the valet, Constant, who was amused to witness the struggle between Cambacérès's determination to admire Napoleon and his loyalty to Kant. The courtier grumbled that people often disparaged works of pure reasoning simply because of the trouble it took to comprehend them. "I enjoyed his little annoyance with the emperor (an annoyance he would not have admitted for all the world)," recalled Constant, "and took great pleasure in chatting with him."<sup>2</sup>

German philosophy was the farthest thing from Napoleon's taste. So too was Jean-Baptiste Lamarck, author of the discipline of biology and of the first fully elaborated theory of the transformation of living forms, or what we would now call evolution, who personified all that the Little Corporal most reviled. In particular, Lamarck personified a new sort of historical natural science that had been emerging over the previous half-century. Napoleon's imperial aversions were personal, intellectual, and political in equal measure. His dismissal of history and philosophy as modes of naturalist scientific understand-

ing—let us call it “Napoleonism” to follow in that era’s neologic tendency—had important repercussions for the subsequent development and history of science, especially the life sciences.<sup>3</sup>

By way of explanation, first, another story, probably the most frequently told story about Lamarck. Its source is the astronomer François Arago, and it took place when Arago was a young man of twenty-three. On a frigid day in December 1809, the members of the Institut de France attended the emperor in a chilly salon of the Palais des Tuileries to present to him their new publications. The savants and men of letters were dressed in green, the aides de camp in gold brocade. Standing next to the young Arago was Lamarck, now sixty-five and in ill health, though he would live another two decades. Lamarck held a copy of his *Philosophie zoologique*, the magnum opus in which he developed the powerful idea that living forms might transform themselves continually toward greater complexity and in response to their environments. Arago and Lamarck together wryly observed the apparent panic of each of the men around them that he might fail to receive the emperor’s notice.

Napoleon at last entered the room and approached Arago as he would a new conscript, fixing him with a stare and barking, “You’re very young! What’s your name?” Before Arago could answer, his neighbor on the left, eager to be noticed, replied, “He cultivates astronomy!” Napoleon: “And what have you done?” Arago’s neighbor on the right, not to be outdone, announced, “He has just measured the meridian in Spain!” While Arago ruefully reflected that Napoleon must take him for a mute or an imbecile, the emperor turned to Lamarck, who presented his *Philosophie zoologique* (fig. 1). Not even looking at it, Napoleon growled “What is that? It’s your absurd meteorology . . . that volume which dishonors your advanced years. Do natural history and I’ll receive your works with pleasure; this one I take only out of consideration for your white hairs. Give it here!” Still without looking at the book, Napoleon thrust it into the hands of



Figure 1.  
*Jean-Baptiste De Lamarck  
Handing the Book "Zoological  
Philosophy" to Emperor Napoleon  
Bonaparte, Mikhail Dmitrievich  
Ezuhevsky, 1920 (pastel on  
paper). Courtesy of Bridgeman  
Images.*

an aide de camp, while Lamarck, tears of frustration rolling down his cheeks, protested in vain that it *was* in fact a work of natural history.<sup>4</sup>

Quite apart from the fact that what Lamarck held in his hands was not one of his annual meteorological treatises, you may well wonder why Napoleon deemed these a disgrace, and I will come to that in a moment. But first a note about the phrase “natural history” as Napoleon employed it. This phrase had been undergoing a trans-

formation from an older meaning toward a newer one, partly at the hands of none other than the late philosopher whom Napoleon so disliked, Immanuel Kant. Napoleon used “natural history” emphatically in its older sense, a usage that had frustrated Kant, who had regretted that the phrase in common parlance denoted the static “description of nature,” whereas he wanted to designate a new form of natural history that would study transformations in nature over time. These transformations were the results of “wholly undesigned mechanical generation,” yet exhibited a purposive self-organizing agency. For the new kind of natural history that would study these ongoing processes of immanent mechanical generation, since the word “history” seemed already taken for another purpose, Kant had proposed “archaeology of nature.”<sup>5</sup>

When Napoleon admonished Lamarck to stick to “natural history,” although the emperor had the older sort of natural history in mind, Lamarck himself had in fact just reinvented natural history along Kantian lines, to study nature as a continual process of secular, material transformation driven from within by various internal agencies, and the results were in the book he proffered to the emperor.

This momentous book, Lamarck’s *Philosophie zoologique*, explained how living beings could transform themselves in infinitesimal, incremental, and heritable ways that, when added together over generations, could explain the adaptation of organisms to their environments. Lamarck’s theory made no reference, either implicit or explicit, to any kind of external divine agency, but rather to two different sorts of internal, organic agencies propelling the development of living beings from within. The first was a natural force like the forces of contemporary experimental physics, such as gravity, electricity, or magnetism: a rudimentary upward-striving *pouvoir de la vie* that drove living matter to elaborate and complicate its organization over time. This force began with the most rudimentary form of life, a mere “animated point,” and acted over an “incalculable series of centuries.” Organisms de-

veloped, grew, and transformed from that first tiny point through the action of the *pouvoir de la vie* purely as a result of their own movements, specifically the movements of fluids within them. Plants and animals were the sole beings on the planet to form themselves this way, Lamarck emphasized, using materials of their own composition.<sup>6</sup>

In addition to this rudimentary upward-striving force of composition and complexification, according to Lamarck, another kind of agency acted as well: responsiveness, an ability to react to the environment. In lower organisms, this responsiveness took various primitive and rudimentary forms, but from the level of birds and mammals, the responsiveness took the form of acts of will, through which animals formed “habits” and “ways of life” in response to their circumstances. Through this agency they gradually transformed their bodies. “When the will determines an animal to perform a given action,” Lamarck wrote, “the organs that must execute this action are immediately provoked by the affluence of subtle fluids” to carry it out. Many repetitions of these “acts of organization” would then “fortify, extend, develop and even create the necessary organs.”<sup>7</sup>

Lamarck was convinced, moreover, that such a process was the only way to account for sentient life, because if each creature owed its organization to an exterior and foreign source, then instead of being animate machines, animals would have been “totally passive machines,” lacking “sensibility or the intimate sentiment of existence,” with no power to act, nor ideas, nor thought, nor intelligence. In short, they would not have been alive.<sup>8</sup> Had Napoleon known what was in the book he grudgingly accepted from Lamarck, with its revolutionary understanding of living nature as continually creating and recreating itself from raw matter, he would surely have liked it even less than the meteorological annals (and I’m still coming to why he disliked those!). Lamarck’s book was indeed a “natural history,” but in the newest and most radical sense of the phrase.

A corresponding new sense of “history” was coming into usage in relation to the development of human society as well as of natural living forms. For example, Voltaire, who had transformed the writing of history in the middle decades of the eighteenth century, carefully distinguished profane from sacred history (the latter, he said, was a respectable endeavor but not his subject), ruling out gods, fables, anything counter to natural law, and in general, “all that violates the ordinary course of nature.” The categorical distinction of profane from sacred history and the attachment of profane history to the “course of nature” moved the meaning of “history” in a naturalist, empiricist direction. Voltaire further observed that these standards dictated that one consider the element of *time* as necessary to the emergence of complex phenomena. The astronomical achievements of the Babylonians, for instance, indicated that they had existed as a people for a great many centuries. “Arts are but the product of time, and the natural laziness of men leaves them for thousands of years without any knowledge or talent except to nourish themselves, to defend themselves and to kill each other.” Similarly, the first Egyptian cities must have existed “a prodigious time” before the pyramids, in order for the ancient Egyptians to have developed the skills and tools needed to build them. Having restricted historical explanations to processes within “the ordinary course of nature,” Voltaire considered time not only as chronology, but also as a necessary dimension in the production of human history.<sup>9</sup>

During the previous half-century, then, influential people including Voltaire and Kant had been reaching for a new mode of historical understanding in relation to both human and natural history. This new mode of historical understanding would in fact bring the two, natural and human history, together by explaining complex phenomena in both domains as the results of intrinsic, contingent, material processes operating over time, carrying a great variety of agencies into

engagement with one another. The volume Napoleon scornfully received from Lamarck represented an important culmination of these efforts. It was a “natural history” in the newest and most cutting-edge sense, and as I’ve mentioned, had he but known it, Napoleon would have disliked the work even more than he disliked Lamarck’s meteorological annals.

Now let me come finally to why Napoleon deemed Lamarck’s meteorological annals a disgrace, since it is ultimately for the same reason that he would have disliked the *Philosophie zoologique*. The most immediate cause of Napoleon’s disdain for Lamarck’s meteorological annals was that Napoleon’s teacher and supporter, and an influential member of his inner circle, the astronomer and mathematician Pierre-Simon de Laplace, whom he had recently made a count of the Empire, had assured him that these annals were nonsense, that Lamarck had an overactive imagination and no scientific talent.<sup>10</sup> Several years earlier, in 1802, when Lamarck had tried to read one of his meteorological memoirs to the members of the First Class of the Institut, Laplace had scornfully interrupted him and commenced a campaign to cast the work as outdated superstitious nonsense.<sup>11</sup> Laplace had ridiculed Lamarck’s meteorology in both loud and subtle ways, for example, as Lamarck lamented, by constantly referring to it as an “almanac,” and to the probabilistic reasoning it contained as “predictions.”<sup>12</sup> But if Laplace’s loathing of Lamarck’s meteorology explains Napoleon’s attitude, what can explain Laplace’s?

Once again, it was personal, and intellectual, and political. As a young man of thirty, Laplace had entered into an especially fruitful collaboration with the academician Antoine Lavoisier, a chemist, tax collector, and philosophical revisionist, who had since been guillotined during the Revolution, but whose New Chemistry remained alive, if embattled. Together, Lavoisier and Laplace had performed a series of experiments on heat intended to do no less than remake the general understanding of the nature of matter. They claimed to have decom-

posed water, hitherto considered an element, into two separate kinds of air; and to have established, with the help of a long-suffering guinea pig, that respiration was a form of combustion, in which the respiring creature took oxygen from the air and combined it with carbon to produce carbon dioxide.<sup>13</sup> Implicit in these experiments and their interpretation was the New Chemistry (Lavoisier himself regarded it as a whole new science), also known as the “pneumatic chemistry” because it reduced all matter to varieties of air. The New Chemistry differed not only from the old chemistry, with its four Aristotelian elements, earth, air, fire, and water, but from the newer old phlogiston-based chemistry, in which “phlogiston”—the matter of fire, heat, and light—acted as the principle of all formation, composition, life, and growth.<sup>14</sup> The New Chemistry lacked any such active principle or agency, merely charting decompositions and recompositions of elements by weight.<sup>15</sup>

During the Napoleonic years, phlogistonists with their active and fiery view of nature and pneumaticists with their essentially inert, passive, and airy one remained embattled.<sup>16</sup> Laplace’s and Lavoisier’s victory was by no means secure, and Lamarck was among those who vehemently and publicly rejected the pneumatic chemistry in favor of his own “pyrotic theory,” in which fire, as in phlogiston chemistry, played a key role, though not the starring role, which in Lamarck’s theory went to living beings. These, through their “organic action,” were the “principal productive cause of all compounds that exist.”<sup>17</sup>

According to Lamarck, the myriad forms of matter in the world originated when living beings produced compounds, supplying these to the forces of nature, particularly the matter of fire, that then acted upon them to produce as “residues” the various kinds of inanimate matter. How the first living beings had come to exist, and whether there had already been inanimate matter such as minerals at the time, Lamarck confessed himself unable to know. But with regard to the present state of nature, he identified living things as the origin of every

kind of compound matter, actively generating the building blocks for the matter of fire to forge into inanimate compound matter.<sup>18</sup> In his meteorological annals, Lamarck not only put these ideas to work, but did so in a way that marshaled government support to coordinate scientific activity across France as meteorological observations poured in from every corner.<sup>19</sup>

Little wonder that Laplace hated Lamarck and his meteorological treatises, and that he communicated these hatreds to his powerful patron. It was personal and at the same time it was intellectual and political: Laplace categorically rejected the view of nature that Lamarck developed throughout his work, including in the meteorological treatises, according to which the natural world itself—its very matter—emerged from the actions of organisms over time, as living beings continually generated and transformed the world around themselves.

The emperor had been further prepared for his act of public disdain toward Lamarck by another of his supporters and favorites, and another of Lamarck's colleagues and foes, the naturalist Georges Cuvier. The forty-year-old Cuvier held the chair in comparative anatomy at the *Jardin des plantes*, where Lamarck had been named a lowly professor of insects and worms but had reconceived his post under a revisionary term of his own coinage, "invertebrates." While Cuvier's career under Napoleon was very much in the ascendant—Napoleon had appointed Cuvier, and would go on appointing him, to a succession of ever higher administrative posts<sup>20</sup>—Lamarck's career, despite, or rather, because of the powerful theory at which he was arriving, was on the sharp decline.

Cuvier represented science that was cutting edge, and at the same time, that bolstered rather than threatened an authoritarian order, first Napoleon's, and then that of the Bourbon Restoration (Charles X would make him a baron). It was emphatically not the science of the materialist, atheist revolutionaries from whom Napoleon took such pains to distance himself in his ongoing struggle to seize and retain

the royalists' ground. But nor was it the older science of the Catholic Church. Cuvier, in his Protestantism—he was a devout Lutheran—translated the authority of religion into science, a powerful modern concoction. Moreover, this was a perfectly Napoleonist concoction, to try out our neologism, enlisting religious ideas in the service of an absolute secular authority. Cuvier's central anatomical principle, the principle of correlation of parts, was an assertion of rational design: he claimed that one could infer all the parts of a creature from any single part because they all followed from one another by rational necessity. Cuvier's successes at predicting fossil discoveries appeared to vindicate this principle, though he also applied an extensive knowledge of comparative anatomy to the task.<sup>21</sup>

Cuvier was firmly committed to the fixity of species and understood the fossils of extinct creatures to reflect not transformation, but rather a series of catastrophes, each eliminating the creatures of a given time and place, to be replaced later by brand new, equally fixed and unchanging creatures. In the service of this theory, Cuvier conducted meticulous comparative studies of anatomical structures that led him to revisionary taxonomic changes such as the division of what had simply been “worms” into “internal worms”—those such as intestinal parasites that lived inside other organisms—and “external worms,” such as earthworms. Lamarck, however, had casually hijacked Cuvier's new taxonomic categories to argue for what Cuvier absolutely rejected, namely, the continual transformation of living forms.

In Lamarck's view, as Stephen Jay Gould has shown,<sup>22</sup> Cuvier's new categories opened up a true can of worms by destroying the old notion that living beings were arranged on a ladder of increasing complexity. Internal worms were more complex than jellyfishes and sea urchins in some respects, for example, they had bilateral symmetry and directional motion, but lower in others: they lacked both nervous and circulatory systems. To Lamarck, the internal worms thereby pointed the way from a ladder of complexity toward a branching tree in which

the branches represented adaptive responses to various environments. He thus used Cuvier's taxonomic categories to subvert Cuvier's principle of fixity of species and his catastrophist understanding of fossils.

These principles of Cuvier's, which Lamarck had hijacked Cuvier's own results to overturn, implicitly supported the doctrine of special creation, that God had created each species for its niche in nature and had replenished the supply of creatures following each catastrophe (such as the Great Flood) by new acts of creation. Cuvier's support for the doctrine of special creation was implicit in his science, but what was explicit was the absolute authority of science against the dangerous radicals of France's previous chapter. This could hardly have been better suited to Napoleon's purpose. Here was a scientific doctrine of revolutionary change that was at the same time profoundly conservative, each revolution imposed from outside rather than rising up from within, each a return to the same ultimate authority, and the whole thing guaranteed, not by the Church but by Napoleon's own *savants*.

Lamarck's natural world of inherent active powers, its substance literally generated and shaped by its own living denizens—a historical view of nature in the new sense of the term—was precisely the wrong vision of nature for Napoleon. By association with the likes of Laplace and Cuvier—and with them, against Lamarck and the sort of natural philosophy he represented—Napoleon claimed for himself and his political order the absolute authority of religion translated into modern science. In relation to that supreme, modern, and scientific authority, Lamarck's view of nature and natural science was plainly subversive. In vain did Lamarck lament and protest—"What a strange thing" to ban the work of someone such as himself, "not writing at all about politics, and occupying himself only with studies of nature"—but Napoleon was no fool and could see perhaps indeed more plainly than Lamarck himself that Lamarck's approach to natural history,

making it “historical” in Voltaire’s and Kant’s sense of the word, undermined the very foundation of the new Napoleonist mode of authority.<sup>23</sup> Laplace and especially Cuvier were, by and large, the victors who wrote the histories. In Cuvier’s case, indeed, he wrote Lamarck’s official “eulogy.”<sup>24</sup> It was in fact an anti-eulogy, in which Cuvier described Lamarck’s theory as poetry rather than science, which condemnation set the dominant tone for assessments of Lamarck’s ideas for a long time to come.

## Act 2. A Naturalist Shows the Earthworm Great Respect

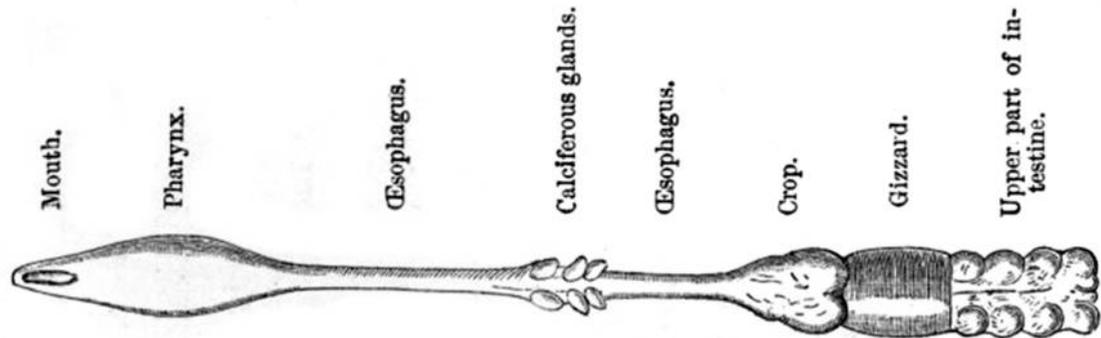
During the remainder of this essay, I’d like to indicate the outlines of the mixed fortunes of this new, historicist approach to natural history, Lamarck’s sort of historicism, over the course of the nineteenth century: through Charles Darwin’s career and those of his followers to the establishment of neo-Darwinism at the turn of the twentieth century. The meaning and relevance of historical understanding in natural science remained controversial throughout these developments, once again for reasons that were simultaneously personal, intellectual, and political.

Although Darwin was abidingly uneasy about Lamarck’s influence on his thinking, his own understanding of “the changing history of the organic world” was fundamentally historical in Lamarck’s (and Voltaire’s and Kant’s) sense. Darwin was also influenced in this historicist direction by the work of his grandfather, Erasmus Darwin, who had described the living form as undergoing continual transformation through its own intrinsic power to acquire new parts and propensities, its “faculty of continuing to improve by its own inherent activity.”<sup>25</sup>

Charles Darwin regarded the geological record as a collection of fragments of the most recent volume of “a history of the world imperfectly kept, and written in a changing dialect.” He urged people to join him in considering natural history in these terms: to “regard every

production of nature as one which has had a history” to be pieced together from scant evidence; and these histories in turn as representing “the summing up of the labour, the experience, the reason, and even the blunders of numerous workmen.” Darwin promised that this change of approach would be its own reward: “when we thus view each organic being, how far more interesting, I speak from experience, will the study of natural history become!”<sup>26</sup> Natural history would in fact become “interesting” in the way of human history, a chronicle of attempts and trials, triumphs and gaffes, peopled by countless sorts of characters.

In keeping with this historicist approach, Darwin’s nature was driven and shaped by many “small agencies” in conflict and collusion. He remained deeply engrossed in these throughout his life. A taxonomic study of barnacles, early in his career, occupied him for eight long years, and his last major work, published just the year before he died, was a eulogy to the lowly earthworm (you will have noticed that worms and their agency are a running theme in this tale). The moral of Darwin’s earthworm story was the earthworm’s ability, through its humble and minute mode of activity, to play a role of prodigious importance in shaping the landscape. The very agricultural economy of England depended on the actions of earthworms (fig. 2). These creatures could thereby serve as an example to people inclined to overlook the importance of diminutive operators in natural history. “Even Elie de Beaumont, who generally undervalues small agencies and their accumulated effects,” Darwin observed, *even* Beaumont acknowledged the importance of the “vegetable mould” or humus produced by earthworms. (The French geologist’s theory of mountain ranges, ascribing these to single, sudden causes, had brought him into conflict with Darwin’s great friend, the uniformitarian Charles Lyell, and through Lyell, with Darwin himself, whose ideas Beaumont purportedly dismissed as “frothy science,” a remark that much rankled the sensitive Darwin.)<sup>27</sup> Moreover, the earthworms’ activity was itself conjoined



with that of even smaller agencies, and also only slightly larger ones, for example, moles and burrowing larvae and insects, especially ants, that brought fine earth up to the surface.<sup>28</sup>

Moreover, earthworms exhibited a “degree of intelligence,” Darwin emphasized, rather than acting by “mere blind instinctive impulse,” as was evident in the fact that they varied their behavior to suit the context. For example, they positioned leaves and other objects to plug up the mouths of their burrows according to the shapes of the spaces and the objects in question. The work of earthworms, in addition to being essential to ecology and to agriculture, was a work of art. Darwin concluded:

When we behold a wide, turf-covered expanse, we should remember that its smoothness, on which so much of its beauty depends, is mainly due to all the inequalities having been slowly levelled by worms. It is a marvellous reflection that the whole of the superficial mould over any such expanse has passed, and will again pass, every few years through the bodies of worms. The plough is one of the most ancient and most valuable of man’s inventions; but long

Figure 2.  
Diagram of the alimentary canal of an earthworm (*Lumbricus*), copied from Ray Lankester in *Quart. Journ. of Microscop.* vol. xv. N.S. pl. vii, in Charles Darwin, *The Formation of Vegetable Mould, through the Action of Worms, with Observations on their Habits* (London: John Murray, 1881), fig. 1, p. 18. Reproduced with permission from John van Wyhe, ed. (2002), *The Complete Work of Charles Darwin Online* (<http://darwin-online.org.uk/>).

before he existed the land was in fact regularly ploughed, and still continues to be thus ploughed by earthworms.<sup>29</sup>

Darwin's greatest German disciple, Ernst Haeckel, the most successful promulgator of Darwinism in the period up to World War I,<sup>30</sup> was a champion of what I have been characterizing (and what he himself characterized) as a historical approach to natural history. Haeckel vehemently rejected contemporary "mechanist" approaches in embryology, whose practitioners claimed to divorce mechanical from historical causation. His primary target and abiding enemy was the Swiss anatomist and embryologist Wilhelm His, a crusader for a mechanist and specifically nonhistorical approach to biology.<sup>31</sup> In response to His's push-me-pull-you mechanical explanations of the phases of embryological development, Haeckel objected that such an approach "fancies it has found the real *mechanical* causes of the facts of embryology when it has traced them to simple physical processes, such as the bending and folding of elastic plates." But this approach was only "pseudo-mechanical" in its attempt "to reduce the most complex historical processes to simple physical phenomena." These physical phenomena were incomprehensible, Haeckel argued, unless one placed them in the context of their evolutionary causes and realized "that each of these apparently simple processes is the recapitulation of a long series of *historical* changes." Biology itself was a fundamentally historical discipline, according to Haeckel, the greater part of the phenomena with which it dealt being "complicated *historical processes*."<sup>32</sup> For this reason, Haeckel classified evolutionary theory as a field situated between the natural sciences (*Naturwissenschaften*) and the humanities and social sciences (*Geisteswissenschaften*).<sup>33</sup>

History was Haeckel's reply not only to the push-me-pull-you mechanist approach of His, but also, at the opposite extreme, to the supernaturalism of other opponents of his. One critic, for example, the Strasbourg zoology lecturer Alexander Goette, rehearsed the standard

objection that neither Haeckel nor Darwin had offered a mechanism for variation or heredity, insisting that the emergence and preservation of form through these processes could only have a “supernatural” origin.<sup>34</sup> Haeckel responded to such critics that the agency responsible for bringing about nature’s machinery acted over time: historical emergence provided a “completely sufficient explanatory basis” for complex form.<sup>35</sup> Each mechanical event in the development of a given individual organism was “a highly complicated historical result” of thousands of evolutionary modifications,<sup>36</sup> and the naturalism of evolutionary theory rested upon this combination of mechanism and history.

Herein too lay the answer to the age-old question: Which came first, the chicken or the egg? “We can now give a very plain answer to this riddle,” Haeckel wrote. The historical approach to embryology revealed that the “egg came a long time before the chick.” It did not exist at first as a bird’s egg, of course, but “as an indifferent amoeboid cell of the simplest character.” The egg had spent thousands of years as an amoeba and had not become an egg in the modern physiological sense until the descendants of the unicellular protozoa had developed into multicellular animals, which had then undergone sexual differentiation. “The bird’s egg we have experience of daily is a highly complicated historical product,” and only by seeing it as such could one understand its current function in producing a chick.<sup>37</sup> Haeckel wrote:

I am one of those scientists who believe in a real “natural history,” and who think as much of an historical knowledge of the past as of an exact investigation of the present. The incalculable value of the historical consciousness cannot be sufficiently emphasised at a time when historical research is ignored and neglected, and when an “exact” school, as dogmatic as it is narrow, would substitute for it physical experiments and mathematical formulae. Historical knowledge cannot be replaced by any other branch of science.<sup>38</sup>

Sharing this conviction was the Dutch botanist Hugo De Vries, author of the first attempt to integrate a genetic theory of inheritance into a Darwinian framework. De Vries wrote that protoplasm was a historical entity, in a state of continual self-transformation, its current physico-chemical properties offering only a momentary, static, and insufficient glimpse of its functioning. One must therefore base physical and chemical explanations in historical understanding. De Vries proposed a material medium for the historical dimension of living substance: units that he called “pangenes.” The structure or composition of these he declined to specify other than to say that they were extremely complex “material bearers for the individual hereditary characters.”<sup>39</sup> The essential principles of De Vries’s historical theory of heredity were first, that each hereditary character corresponded with a “pangene”; second, that every pangene existed in each cell of the body; but, third, that each was “active” only in certain cells. The defining feature of De Vries’s pangenes was that they were “life-units, the characters of which can be explained in an historical way only.”<sup>40</sup>

The tide, however, was turning against the historical approach to natural history as practiced by Lamarck, Darwin, Haeckel, and De Vries.

### Act 3. (Really More of an Epilogue): Napoleonist Natural History Triumphs and a Return to Stanford’s Techies and Fuzzies

A zoologist and embryologist at the University of Freiburg, August Weismann, was arriving at a new version of Darwinism that rigorously purged from the theory all traces of Lamarckian historicism. It would be difficult to overstate the transformative importance of Weismann’s interpretation of Darwin’s theory: it became the standard by which biologists distinguished legitimate from counterfeit Darwinism and has remained so right through the twentieth century and into the twenty-first. In Weismann’s version of Darwinism, there were no “small agen-

cies” driving the process of evolution, but only random variations and the external action of natural selection. Weismann categorically denied both of Lamarck’s forms of internal agency, the upward-striving *pouvoir de la vie* and the many forms of responsiveness in living organisms.

Like His, Weismann also rejected historical explanation in biology. By “historical” explanation, these biologists had in mind the Lamarckian-inflected version of Darwinism, for example, as instantiated in Haeckel’s science, according to which living forms developed gradually and contingently, driven and directed by their own inner agencies. Weismann and others in this antihistorical generation of biologists rejected the idea that intrinsic agencies operate in nature, and they also repudiated something else that this idea brought to scientific explanation: contingency. Contingency is neither randomness nor determinism, but something altogether different. It is the product of limited agencies working in particular changing situations. Biologists around the turn of the twentieth century described change over time, taking place through a combination of random and mechanically determined events, but not contingent change directed by tendencies or actions within the living organisms themselves.<sup>41</sup>

Weismann therefore also disparaged De Vries’s notion of “historical characters” of living matter. Protoplasm, he objected, possessed historical qualities “not in addition to, but within their physico-chemical ones,” meaning simply that adaptation and selection had shaped their structure over many generations.<sup>42</sup> The mere fact that the physical and chemical properties of protoplasm had arisen gradually made no difference to understanding how they operated or to reproducing them artificially. Weismann’s own elements of inheritance, “determinants,” did not correspond with hereditary characters but rather with discrete organs or parts: they were minute machines each of whose job it was to physically construct a part of the organism, and were to be understood in purely mechanical terms.<sup>43</sup> In this sense Weismann’s determinants were the very opposite of De Vries’s pangenesis.

Furthermore, soon after De Vries's publication of his ideas about pangenes, the Danish botanist Wilhelm Johannsen coined the term "gene," deliberately distancing these "elements of inheritance," as he understood them, from both Weismann's minute machines and De Vries's historical bearers. Johannsen offered his new term as innocent of any implications, either historical or mechanical. "Gene" was simply, he claimed, "a very applicable little word, easily combined with others," that would "prejudice nothing."<sup>44</sup> But of course the term "gene," like all terms, certainly did carry implications, in particular, a powerful antihistorical implication. Regarding a "genotype," the "sum total of all the 'genes' in a gamete," Johannsen wrote, "its history is without influence upon its reactions, which are determined by its actual nature. The genotype-conception is thus an 'ahistoric' view of the reactions of living beings." Johannsen recommended his genotype conception of heredity as a "'radical' ahistoric" conception, in its "strict antagonism" to the contrasting, historicist, "phenotype-view" of—yes!—Lamarck.<sup>45</sup>

Weismann's powerful antihistorical neo-Darwinism together with Johannsen's powerful antihistorical language of genes and genotypes—although they emerged long after the end of Napoleon's reign—marked a lasting triumph for Napoleonist science, one that endured through the twentieth century and beyond: an approach to nature that was specifically nonhistorical, whose authority resided in its deliberate and explicit divorce from humanistic modes of understanding and explanation.

To return at last to the divided intellectual and social world at Stanford, the Techies and the Fuzzies with whom I began, this is the lasting legacy of the establishment of Napoleonist science in the nineteenth century. Indeed, Stanford was founded precisely in the middle of the period during which Weismann was establishing and presenting to the world his antihistorical version of Darwinism, in 1885. Moreover, David Starr Jordan, Stanford's first president, in addition to being an ichthyologist and a eugenicist, was also a devoted Weismannian.

“The work of Weismann was epoch-making,” Jordan wrote. “We owe to him the more rigid definition of natural selection, by which the Lamarckian element, the supposed inheritance of characters not inborn, was eliminated from the definition of Darwinism.”<sup>46</sup> Little wonder that my students see themselves as *either* Techies or Fuzzies, and the two as distinct by definition: the distinction was built into the very foundation of their university.

However, I am here to tell you that at Stanford itself, in the very heart of Napoleonist science, the “small agencies”—including the agencies of worms and insects—are making their slow but steady way back into the heart of evolutionary biology. These slight but sure actors have been carrying something along with them beyond their bits of leaves and dirt: they’ve been carrying a historicist mode of understanding clear across campus between History Corner and the Science Quad, to and fro. They’ve therefore also been bringing historians into regular and rich conversation with students and faculty in the life sciences. Deborah Gordon’s research on collective behavior in ant ecology<sup>47</sup> and Marc Feldman’s on niche construction and the interactions of biological and cultural evolution<sup>48</sup> are examples of biology in a historicist mode. Napoleon would be annoyed. But that’s a story for another day.

## Notes

1. For an analysis of Destutt de Tracy's optimistic coinage and how Napoleon transformed it into an epithet, see Maurice Cranston, "That Is an Ideology?" *Revue Européenne des sciences sociales* 17, no. 46 (1979): 59–63.
2. Louis Constant Wairy, *Mémoires de Constant, premier valet de chambre de l'empereur, sur la vie privée de Napoléon, sa famille et sa cour* (Paris: Garnier, 1910), 1:325–26.
3. "Napoleonism" is at once an intellectual and political sort of -ism, not to be confused with "Bonapartism," which has denoted a specifically political approach modeled on that of Napoleon I and, relatedly, advocacy of the House of Bonaparte in the decades after the end of the First Empire.
4. François Arago, *Mémoires de ma jeunesse*, in *Oeuvres complètes de François Arago*, 13 vols., ed. J.-A. Barral (Paris: Gide, 1854–62), 1:1–102, at XLVI.
5. Immanuel Kant, *Critique of Judgement* [1790], trans. James Creed Meredith, ed. Nicholas Walker (Oxford: Oxford University Press, 2007), 256 n. 2. For the older seventeenth- and eighteenth-century meaning, see, e.g., the article on "Histoire naturelle" in Denis Diderot and Jean d'Alembert, eds., *L'Encyclopédie, ou, Dictionnaire raisonné des sciences, des arts, et des métiers, par une société des gens de lettres* (Paris, 1751–72), 8:225–30. For secondary work on the history of natural history, see Nicholas Jardine, J. A. Secord, and E. C. Spary, eds., *Cultures of Natural History* (Cambridge: Cambridge University Press, 1996); Paul Lawrence Farber, *Finding Order in Nature: The Naturalist Tradition from Linnaeus to E. O. Wilson* (Baltimore: Johns Hopkins University Press, 2000); and Emma Spary, *Utopia's Garden: French Natural History from Old Regime to Revolution* (Chicago: University of Chicago Press, 2000). For a full discussion of Kant's treatment of living nature's apparent purposive, self-organizing agency in relation to scientific explanation, see Jessica Riskin, *Science in the Age of Sensibility: The Sentimental Empiricists of the French Enlightenment* (Chicago: University of Chicago Press, 2002), chap. 6.

6. Jean Baptiste Lamarck, *Philosophie zoologique, ou, Exposition des considérations relative à l'histoire naturelle des animaux*, 2 vols. (Paris: Dentu, 1809), 2:95, 127, *Histoire naturelle des animaux sans vertèbres* (Paris: Déterville, 1801), 50, 134, and *Hydrogéologie, ou, Recherches sur l'influence qu'ont les eaux sur la surface du globe terrestre* (Paris: Chez l'auteur, 1802), 188. On Lamarck's "ceaseless tendency" of living beings to compose and complexify themselves, a "continually active cause," see also his *Philosophie zoologique*, 1:132; 2:69, 100, 101, 104.

7. Jean Baptiste Lamarck, *Recherches sur les causes des principaux faits physiques* (Paris: Maradan, 1794), 50–62.

8. Lamarck, *Philosophie zoologique*, 2:310–11.

9. François Marie Arouet de Voltaire, "Histoire," in *L'Encyclopédie, ou Dictionnaire raisonné des sciences, des arts, et des métiers, par une société des gens de lettres*, ed. Denis Diderot and Jean d'Alembert (Paris, 1765), 8:220–25, at 221–24.

10. Yves Delange, "Les Phénomènes de l'atmosphère et la météorologie de Lamarck," in *Jean-Baptiste Lamarck, 1744–1829*, ed. G. Laurent (Paris: Éditions du Comité des travaux historiques et scientifiques, 1997), 133.

11. See Richard Burkhardt, *The Spirit of System: Lamarck and Evolutionary Biology* (1977; repr., Cambridge, MA: Harvard University Press, 1995), 10, 225 n. 20. Burkhardt identifies the memoir in question as "Mémoire sur les variations de l'état du ciel," later published in the *Journal de physique* 56 (1802): 114–38. The primary source of the incident is a letter from Étienne Geoffroy de Saint-Hilaire to Georges Cuvier, Institut de France, Fonds Cuvier, Ms 3225 (12).

12. Cited in Delange, "Phénomènes," 134.

13. Antoine Laurent Lavoisier and Pierre Simon Laplace, "Mémoire sur la chaleur," in *Mémoires de l'Académie des sciences* (1780 [1783]): 355–408, and "Mémoire dans lequel on a pour objet de prouver que l'eau n'est point une substance simple" [1781], in *Oeuvres de Lavoisier*, 6 vols. (Paris: Imprimerie Royale, 1862–93), 2:334–59.

14. See Riskin, *Science in the Age of Sensibility*, chap. 7, for a discussion of the struggle (and its politics) between adherents of phlogiston chemistry and proponents of the New Chemistry.

15. For this reason, Hasok Chang has characterized the New Chemistry as "compositionist" in contrast with the older "principlist" approach. See Chang, "The Hidden History of Phlogiston: How Philosophical Failure Can Generate Historiographical Refinement," *HYLE: International Journal for the Philosophy of Chemistry* 16, no. 2 (2010): 47–79.

16. On the persistence of phlogiston chemistry among younger as well as older natural philosophers during the last decades of the eighteenth century

and first decades of the nineteenth, see *ibid.*; see also D. M. Knight, *The Transcendental Part of Chemistry* (Folkestone, Kent: Dawson, 1978), 29.

17. Jean Baptiste Lamarck, *Réfutation de la théorie pneumatique* (Paris: Agasse, 1796), 996; see also Lamarck, *Recherches*, 384, 391.

18. Lamarck, *Recherches*, 11.

19. Delange, “Phénomènes,” 134.

20. Étienne Pasquier, *Éloge de M. le baron Georges Cuvier. Chambre des Pairs. Séance du 17 décembre 1832* (Paris: [n.p.], 1832), 15–19.

21. Martin Rudwick, *The Meaning of Fossils: Episodes in the History of Palaeontology* (New York: Elsevier, 1972), 104–15.

22. Stephen Jay Gould, “A Tree Grows in Paris: Lamarck’s Division of Worms and Revision of Nature,” in *The Lying Stones of Marrakesh: Penultimate Reflections in Natural History* (New York: Harmony, 2000), chap. 6.

23. Jean Baptiste Lamarck, “Météorologie,” in *Nouveau dictionnaire d’histoire naturelle, appliquée aux arts, à l’agriculture, à l’économie rurale et domestique, à la médecine, etc. Par une société de naturalistes et d’agriculteurs*, 20:451–77, at 475.

24. Georges Cuvier, “Eloge de M. de Lamarck, lu a l’Académie des sciences, le 26 novembre 1832,” *Mémoires de l’Académie Royale des Sciences de l’Institut de France* 8 (1935): i–xxxii, at xx.

25. Erasmus Darwin, *Zoonomia, or the Laws of Organic Life*, 2 vols. (London: J. Johnson, 1794–96), 1:505. For more discussion of Erasmus Darwin’s ideas about species change, see Jessica Riskin, *The Restless Clock: A History of the Centuries-Long Argument over What Makes Living Things Tick* (Chicago: University of Chicago Press, 2016), chap. 7.

26. Charles Darwin, *On the Origin of Species by means of natural selection, or the preservation of favoured races in the struggle for life* (London: John Murray, 1859 [1st ed.]), 103, 311–12, 485–86.

27. On Elie de Beaumont’s conflict with Lyell and Darwin, see Lyell–Darwin, 6 and 8 September 1838 and n. 2, in DCP-LETT-425 and (also for the “frothy science” remark, “de la science mousseuse”) Darwin–Armand de Quatrefages 23 August [1870] and n. 5, in DCP-LETT-7308, Darwin Correspondence Project (DCP), Cambridge University Library, <http://www.darwinproject.ac.uk>.

28. Charles Darwin, *The Formation of Vegetable Mould, through the Action of Worms, with Observations on their Habits* (London: John Murray, 1881), 2, 172.

29. Darwin, *Formation of the Vegetable Mould*, 312–13.

30. On Haeckel's popularization of Darwinism, see Robert Richards, *The Tragic Sense of Life: Ernst Haeckel and the Struggle over Evolutionary Thought* (Chicago: University of Chicago Press, 2008), 2.
31. On the animosity between Haeckel and His, see Richards, *Tragic Sense of Life*, 285–91; and Nick Hopwood, "Pictures of Evolution and Charges of Fraud: Ernst Haeckel's Embryological Illustrations," *Isis* 97 (2006): 260–301. On His's antihistorical program in embryology, see Riskin, *Restless Clock*, chap. 8.
32. Ernst Haeckel, *The Evolution of Man* [1874], trans. Joseph McCabe, 2 vols. (London: Watts, 1905), 1:xix, 83.
33. Haeckel's address to the Society of German Natural Scientists and Doctors (Gesellschaftdeutscher Naturforscher und Ärzte) in September 1877, "Über die heutige Entwicklungslehre"; Richards, *Tragic Sense of Life*, 313–14.
34. Alexander Goette, *Entwicklungsgeschichte*, quoted in translation in Richards, *Tragic Sense of Life*, 293. See also Richards's discussion of Goette in *ibid.*, 291–93.
35. Ernst Haeckel, *Ziele und Wege der heutigen Entwicklungsgeschichte* (Jena: Hermann Dufft, 1875), 21. See Richards's discussion of this passage and Haeckel's notion of "historical natural science" in *Tragic Sense of Life*, 285, 299.
36. Haeckel, *Ziele und Wege*, 24; see Richards, *Tragic Sense of Life*, 299.
37. Haeckel, *Evolution of Man*, 2:507.
38. *Ibid.*, 2:881; Stephen Jay Gould, *Ontogeny and Phylogeny* (Cambridge, MA: Harvard University Press, 1977), 193.
39. Hugo De Vries, *Intracellular Pangenesis: Including a Paper on Fertilization and Hybridization*, trans. C. Stuart Gager (Chicago: Open Court, 1910), 48, 49, 62.
40. *Ibid.*, 70–71.
41. For more discussion of the turn-of-the-century antihistorical turn in biology, especially as enacted by Weismann, see Riskin, *Restless Clock*, chap. 8.
42. August Weismann, *The Germ-Plasm: A Theory of Heredity*, trans. W. Newton Parker and Harriet Rönnfeldt (New York: Scribner's, 1893), 39.
43. *Ibid.*, 45–68.
44. Wilhelm Johannsen, "The Genotype Conception of Heredity," *American Naturalist* 45, no. 531 (March 1911): 129–59, at 130–33. See Evelyn Fox Keller, *The Century of the Gene* (Cambridge, MA: Harvard University Press, 2002), introduction, esp. 1–2.
45. Johannsen, "Genotype Conception," 132, 139.
46. David Starr Jordan, "The Present Status of Darwinism," *The Dial* 43 (July/December 1907): 161–63, at 162.

47. See, e.g., D. M. Gordon, "The Ecology of Collective Behavior," *PLoS Biology* 12, no. 3 (2014): e1001805, <https://doi.org/10.1371/journal.pbio.1001805>.

48. See, e.g., F. John Odling-Smee, Kevin N. Laland, and Marcus W. Feldman, *Niche Construction: The Neglected Process in Evolution* (Princeton, NJ: Princeton University Press, 2003); Oren Kolodny, Marcus W. Feldman, and Nicole Creanza, "Integrative Studies of Cultural Evolution: Crossing Disciplinary Boundaries to Produce New Insights," *Philosophical Transactions of the Royal Society B: Biological Sciences* 373, no. 1743 (2018): 20170048, doi:10.1098/rstb.2017.0048; and Kevin Laland, *Darwin's Unfinished Symphony: How Culture Made the Human Mind* (Princeton, NJ: Princeton University Press, 2017).